Handbook of Tobacco Culture

For Planters in Southern Rhodesia

Issued by the Department of Agriculture,
Southern Rhodesia.

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Preface.

This little handbook is the lineal successor of a similar work issued by the British South Africa Company in 1905, and prepared by Mr. G. M. Odlum, at that time of the Department of Agriculture. The tobacco industry was then in its infancy in Rhodesia, and there was no store of local experience on which to draw, so for guidance it was necessary to look to foreign sources, chiefly, of course, to the United States of America.

Great strides have been made since that time, and to-day we are able to bring together a fund of information gained within our own borders, the outcome of the experience of growers and experts working together, and the results of careful experiment.

Of the above-mentioned book, only a few pages have been retained unaltered yet to it remains the credit of having been the first guide and *vade mecum* of many of our successful tobacco growers. Nor can it be claimed for this work that it is by any means final or in any sense complete. There is without doubt much yet to be learnt regarding tobacco in Rhodesia. All that is here attempted is to bring together what is known regarding the culture and curing of tobacco in this country, in a convenient form, useful alike to the beginner and to the skilled tobacco grower who is not above learning. It is in the nature of the subject that there are many details of prime importance not to be learnt save by personal observation and practice, which cannot be described in print. In the cultivation and in the technique of curing there is an entire art which the uninitiated grower would do well to learn before taking up the task for his own profit. Not only sight, but the senses of smell and touch must be educated, and repeated lessons are needed, especially in flue-curing, as no two barns of tobacco behave precisely alike. Still, it is realised that such a book as this is an urgent need, and that the information locally gained contained therein cannot but be of much assistance to

growers. In knowledge of this sort there is no finality, and criticisms, corrections and suggestions for improvement in future issues will be welcomed and appreciated, in order that the subject matter may be improved and kept thoroughly up-to-date.

This compilation is the outcome of the willing co-operation of many workers whose services deserve recognition, notably Messrs. G. N. Blackshaw, B.Sc., F.C.S., Government Agricultural Chemist; R. W. Jack, F.E.S., Government Entomologist; C. S. Jobling, Devonby, Nyamandhlovu; J. W. Lewis, Government Tobacco Expert; H. G. Mundy, F.L.S., Government Agriculturist and Botanist; W. A. Rice, of the Rhodesia and South Africa Tobacco Co., Ltd.; A. G. Stewart Richardson; and Dr. C. J. Sketchley.

The literary side of the task of preparation has been performed by Mr. W. E. Meade, of the Department of Agriculture, who has also seen the book through the press.

ERIC A. NOBBS,
Director of Agriculture.

Department of Agriculture,
Salisbury, Southern Rhodesia,
March, 1913.

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CHAPTER I.

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INTRODUCTORY.—Tobacco originally was a native of North America, but it has been so long and so extensively cultivated elsewhere that it has become naturalised in many countries. Tobacco is grown in various countries of the Old World, but whether it was known to any part thereof prior to the discovery of America is not clear. The botanical name of the genus *Nicotiana* was given it in honour of Jean Nicot, who is supposed to have been instrumental in introducing the plant into Europe. Nicot, about the year 1560, was an ambassador from France to Portugal, and while residing at Lisbon, received seeds from Florida. The name "tobacco" is said by some to be from a locality in Yucatan, while others claim that it is from *tabac*, a native word for the pipe used in smoking the leaf.

Next to the most common grains and pulses, probably no plant is so widely cultivated as tobacco. It has assumed an importance in modern life only surpassed by a few prominent plant foods and by cotton, and but few nations, civilised or savage, have not become devotees of the pipe or consumers of the weed in some form.

While this seductively aromatic and mildly narcotic plant has been charming the senses of man, it has also been producing the wealth of its culturists, and increasing the revenues of nations. It has assisted at the birth of new lands, and aided in the maintenance of old ones.

The plant thrives in nearly every portion of the world, yet the nations that consume it most largely have been strangely slow in adopting its culture, or in learning the intricacies of its production. America, its natal continent, with its virgin soil, its cheap lands, and its people trained in its culture, remains the mother of the industry to-day.

The Position of the Tobacco Crop in Rhodesia.—Rhodesia has not been slow to appreciate the latent potentialities of the country for tobacco culture, for it is only a few years since the first experiments were made to grow leaf in the Territory. The success attending these efforts has been remarkable, and the industry has gone ahead to such an extent that tobacco may now be regarded as one of the most valuable crops in the country.

The facilities available in Rhodesia for tobacco growing are quite exceptional, and such as probably do not exist anywhere else in the world. The climate and the soil are peculiarly adapted to the culture of the leaf, suitable land is cheap and practically limitless, while the industry is in the very fortunate position of being protected by a special Customs tariff. All unmanufactured tobacco imported into South Africa is subject to a duty of 3s. per lb., while cigarettes brought into the country are taxed 4s. 6d. per lb., with an additional 15 per cent. *ad valorem* charge. The buyers naturally purchase from the cheapest market, and so long as this protection is maintained, providing, of course, the quality is good, the South African product is likely for some time to command a ready sale at prices satisfactory to manufacturer and grower alike.

Although splendid progress has been made since the success and promise of the initial years, the development, gratifying though it is, can yet only be regarded as an indication of what may be expected in the future. Rhodesian tobacco may be said to have made a name for itself, not only in South Africa, but in the markets of the world. Some fears have been expressed on the score of over-production, but growers may rest assured that the South African buyers already in the market can take more good class tobacco than is likely to be produced in Rhodesia for a considerable time, while the world's demands have scarcely yet been touched.

Buyer inspecting samples of Tobacco, Salisbury.

Tobacco growing in Rhodesia at the present time is confined to Virginia and Turkish varieties, although experiments are now being made with cigar leaf. The demand at the present time in South Africa is for Virginia leaf, for which variety the great proportion of the soil of this country is more especially suited, and growers naturally confine themselves principally to this type. The remarks in this book will, therefore, mainly deal with the culture of Virginia tobacco. The buyers require a good bright leaf for manufacturing cigarettes, and as much as 3s. 7d. per lb. has been paid at the auction sale for a first-class sample. At the 1911 sale, one fortunate grower realised 2s. 4½d. per lb. for his crop, while an exceptionally fine parcel of Turkish leaf at the 1912 sale sold for 4s. 7d. per lb.—a record price for Rhodesian tobacco. Good pipe leaf also commands a ready sale, and usually averages 1s. per lb. The cost of production may roughly be placed at from 4d. to 9d. per lb., while 700 lbs. per acre is an average Rhodesian crop.

The history of tobacco growing in Rhodesia may be said to date back to 1904. For some years the Commercial side of the British South Africa Company took the development of the industry in hand, and engaged experts from the United States of America to give farmers advice with regard to the most suitable soils on which to grow leaf, the best methods of sowing, planting, cultivating, topping, suckering, reaping and curing. In addition to this, the Company leased warehouses, to which the tobacco was sent for handling and re-ordering by the experts and subsequent sale. After a time the industry had advanced to such a stage that it was thought advisable to create a separate concern to deal with it, and a new company was accordingly formed, under the title of The Tobacco Company of Rhodesia and South Africa, Limited. The building hitherto rented by the British South Africa Company in Salisbury was found to be inadequate, and the new company erected and equipped spacious premises at this centre for handling growers' crops.

In the early part of the present year (1913), however, the management of the Tobacco Warehouse reverted to the Commercial Branch of the British South Africa Company under the conditions previously obtaining. The system at present in force is for farmers to send their tobacco to the warehouse, where it is graded, re-ordered and baled ready for sale, a small charge being made for the ser-

vice. Advances up to 75 per cent. of the estimated value of the crop are made when the tobacco is received at the warehouse, and the balance is paid over as soon as possible after sale. The tobacco company has organised a manufacturing branch, and a large factory has been built at Bulawayo. Up-to-date machinery has been installed, and the company is now placing on the market various classes of Rhodesian manufactured tobaccos.

A tobacco expert is now attached to the Department of Agriculture, and farmers can avail themselves of his services. Arrangements have also been made for the chemical examination of soils by the Agricultural Chemist, Department of Agriculture, Salisbury, at a charge of £3 for a complete analysis. In submitting soils for analysis, it is recommended to select four or five spots at least, per acre, taking care that these represent as far as possible the general character of the field. If the soil of the area to be reported upon presents notable differences, the samples gathered from the different parts must be kept separate. With each sample the following particulars should be forwarded :—Date of collection, exact location, position (hill side, vlei or flat), peculiarities of soil or sub-soil, behaviour in wet and dry seasons, crops borne, previous manurial treatment, and every circumstance, in fact, which will throw light on its agricultural qualities.

Tobacco Soils.—The tobacco plant readily adapts itself to a great variety of soils. It can, in fact, be produced on any soil where other agricultural crops will thrive; and yet there is no other plant so easily affected by the chemical and mechanical conditions of the soil, for, while the tobacco plant will adapt itself to diverse conditions of soil and of climate, still each distinct type requires certain conditions to give it those qualities of colour, texture, and aroma for which it is prized.

The colour of a soil is largely indicative of its mechanical and, to some extent, its chemical condition. Light coloured soils generally produce bright tobaccos, and dark soils dark coloured tobaccos. Soils containing a large proportion of clay, or which have a large moisture-holding capacity, produce heavy tobacco which cures to a dark brown or red; while soils consisting largely of sand produce tobacco that cures out a yellow or bright colour. Very rich soils that will produce a large leaf will usually produce a tobacco of poor quality.

Auction Sale of Tobacco, Salisbury.

An attempt to produce a tobacco on a soil not suited to the type planted will, in most cases, meet with failure, for the tobacco produced is unfit to place in the same class as the parent plant, and at the same time it is not likely to grade with any other established type, and as a result is unclassed, and sells as nondescript. It is only the exceptional case where a new type is thus established worthy to create a market on its own merits.

Many of the granitic and sandstone areas of Rhodesia will grow good tobacco, but require the application of fertilisers. It may be taken as a guide that not less than 200 lbs. of fertiliser per acre should be used on light sandy soils, but a little more might improve the quality of the tobacco. Some of the best soils are to be found in the sandstone areas, but, generally speaking, our sandstone soils are inclined to be too rich for bright tobacco. Vlei soils, heavy black or red soils grow a leaf too coarse and heavy for market requirements, and soils containing "brack" or alkali should always be avoided. The fertility of the soils can often be fairly determined by the growth of timber or grass. All tobacco soils should have good natural drainage, and it is of particular moment to note whether the granitic soils are underlaid with an impervious sub-soil. New lands, or those freshly broken up from grass, produce the brightest leaf, but their use is conditional on their being worked up to a perfect tilth before planting time.

Climate.—Few plants are so susceptible to climate as is tobacco. Climate largely influences the quality and aroma in the same way that soil influences the texture. In a warm climate the tendency of the leaf is to be gummy, resinous and aromatic. In a cooler climate the leaf will become larger, thinner, and almost without aroma. While the tendency is for the leaf to become thick in warm climates, this tendency may be overcome by other conditions, as excessive rainfall. This is the condition in Sumatra, where the leaf is famous for its fineness of texture. Tobacco grown in regions of excessive rainfall is washed out and devoid of fine aroma. This is understood in Cuba, where the tobacco is not planted until the cessation of the heavy rains. Cold rainy weather increases the acidity of the leaf, and this may have a detrimental effect on the curing and fermentation processes by preventing the action of the

oxidising enzymes. Excessively dry weather also prevents the formation of enzymes, and tobacco grown in dry climates is not likely to develop a fine aroma. A moderate rainfall with warm weather is perhaps the best condition for the production of tobacco. Dry weather during the ripening period is favourable to the preservation of those products that later create the aroma of cured tobacco. This is particularly true if the dry weather be accompanied with heavy dews. The dews incite the leaf to the formation of gums and resins. Hot dry weather causes a greater thickening of the leaves than does moist weather, and leaves grown in the shade are thinner than those grown in the direct sunlight.

Proximity to the sea has a great influence on the quality of the product. Tobacco grown near the sea is poor in combustibility. This is supposed to be due to the action of chlorine in the salt of the sea air. At thirty miles from the coast this influence may be said to have ceased, and in Sumatra good tobacco is grown within ten miles of the coast. The Italian Government will not permit the cultivation of tobacco on land with an elevation less than one hundred and ten feet. This is probably due to the fact that the low lands are near salt water. In dry climates proximity to a body of water, particularly to fresh water, may be an advantage in that it will increase the humidity of the air.

In Sumatra better tobacco is produced on low well-drained lands some distance from the coast, than is produced further back on the mountain slopes. In this instance, texture rather than aroma is the feature sought for, and it may be owing to a difference in the quality of the soil rather than to difference in elevation. The finest tobacco in the world from the standpoint of aroma is grown in the mountain valleys of Western Cuba. The altitude of these valleys is not at all excessive. The supposition is that high elevations are not likely to produce fine tobacco, for heat is an essential to the development of aroma, and the high altitudes are generally cool.

In general, tropical climates will produce aromatic tobaccos, which are the best for cigar fillers, and the cooler portions of the temperate climates will produce thin leaves with but little aroma which are adapted for cigar wrappers. The bulk of the pipe and chewing tobaccos of the world are pro-

Field of Tobacco, Tobacco Plantation Company's Farm, Sublime, Rhodesia.

duced in the warmer portions of the temperate zone. The plant can be grown in any place with two months of weather without frost, but the aroma will depend largely on the temperature and humidity conditions of the district.

The climate of Rhodesia is generally well suited to the growing of bright tobacco, although the rainfall of recent years has been irregular, and has sometimes adversely affected the quality and yield of the crop. Rhodesian leaf takes longer than the American product to grow and to ripen, for which the cool nights are mainly responsible. Cold retards the growth of tobacco, and the leaf, when standing still, deteriorates in quality and flavour. The conditions in the lower parts of this country are eminently suited to tobacco culture, resembling very closely those in Cuba and Sumatra, and it may be that a good cigar wrapper will be grown in these districts.

With a more or less uncertain rainfall, the question of irrigation is engaging the attention of a number of tobacco growers. Holding the opinion that tobacco will mature better with the natural rainfall, we would not go so far as to advocate growing the crop entirely under irrigation, but irrigation would undoubtedly be of great advantage in getting the plants started before the rains arrive, and rapidly grown and ripened before the hot weather is over, thus ensuring the best quality.

Rhodesian Tobacco Planters' Association.—This Association was formed in 1910, and is controlled by a committee of delegates from all the tobacco growing districts of the country. The more pressing business is attended to by an executive committee composed of the following :—Col. Raleigh Grey (Chairman of the Association), Messrs. R. G. Garvin, W. S. McLachlan, H. C. Henderson, G. B. St. Gwynne, Stewart Richardson, J. McChlery, T. Sloan, O. Zimmermann and Dr. Sketchley. The secretaries are Messrs. W. C. Macdonald and Co., Salisbury.

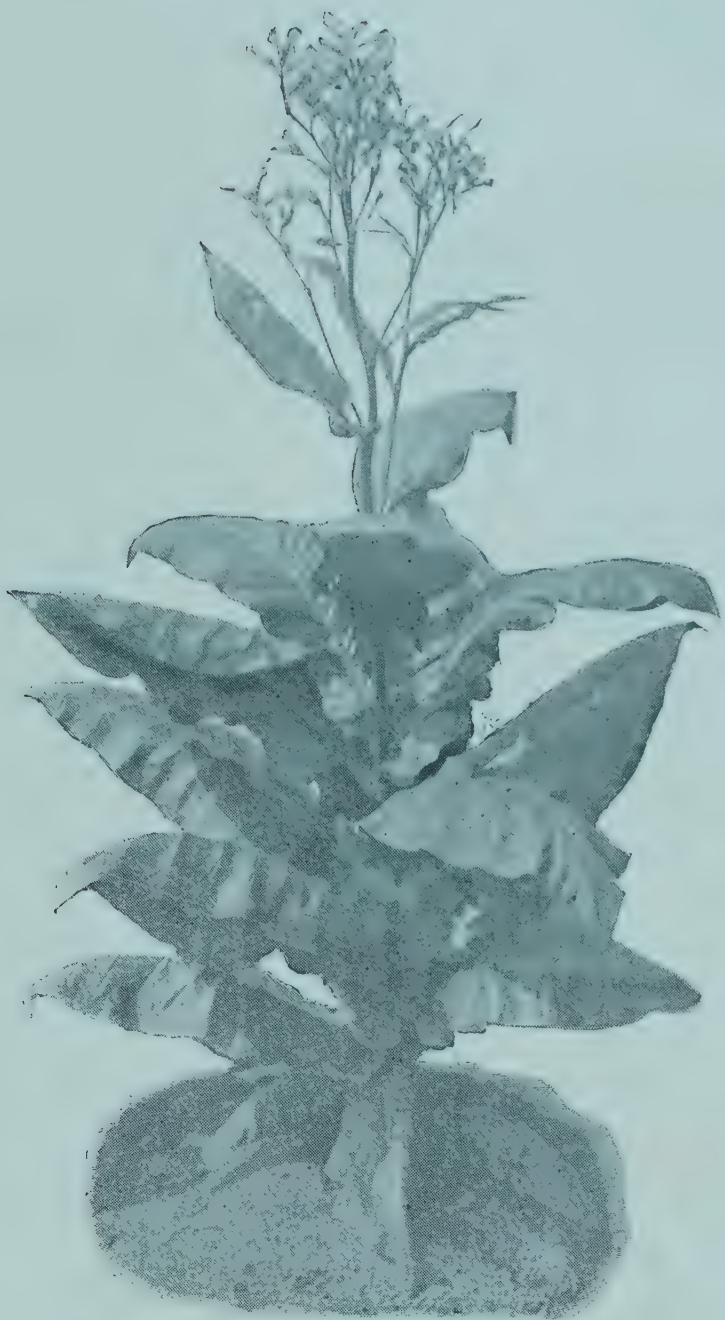
The necessity for a strong combined Association to protect and to further the interests of tobacco growers is self-evident, while there is scope for much useful work for an institution of this description alike in educational, commercial and cultural subjects connected with tobacco culture in Rhodesia.

CHAPTER II.

The Tobacco Plant.—Selection of Varieties.—Classification of Tobaccos.—The Characteristics of a Good Tobacco.—The Seed Bed.—Preparation of the Land.—Planting.—Cultivation.—After Treatment: Topping.—Priming.—Suckering.—Ripening.—Harvesting.—Water in Relation to the Tobacco Crop.

The Tobacco Plant.—The tobacco of commerce is produced from several different species of the genus *Nicotiana*, of which there are some fifty species. *N. tabacum* is the species commonly cultivated in North America. *N. rustica* originally came from South or Central America, where it is grown to a certain extent to-day. It is cultivated also in Germany, Hungary, and Russia, and probably furnishes the Turkish and Latakia tobaccos. The Shiraz tobacco of Persia is a product of the species *N. Persica*. Many different varieties of the more important species have been developed, and it may be that some varieties are the result of a cross of two or even more of the species. Tobacco is a member of the family *Solanaceæ*, to which also belong the tomato, potato, pepper, egg plant, petunia, Cape gooseberry, the datura, and many other common plants, a fact it is well to remember in the cultivation of tobacco or in the combating of its enemies, for the insect pests or diseases of one member of the family are often the enemies of other members.

Selection of Varieties.—Experience has shewn that the varieties of Virginia seed best suited to local conditions are Hester, Goldfinder, Hyco and Warne. Of these, the two latter are not altogether adapted to Rhodesian soils, and are less often met with. Hester and Goldfinder do well and there is little to choose between the two. Hester perhaps produces a slightly richer leaf with more oil in it, but Goldfinder grows a larger and thinner leaf more suited to cigarettes. This seed can be purchased from the Tobacco Warehouse, Salisbury, at 1s. 6d. per oz.



From "Tobacco Leaf : Its culture, cure and manufacture."
Orange Judd Company, New York.

Hitherto in Rhodesia the practice has been to import fresh seed from America for each season's planting. There seems no good reason why this should be done, and, on the contrary, plants grown from acclimatised seed should prove hardier and better suited to local conditions. It has been suggested that were this practice followed, varieties such as Hester and Goldfinder might change their type; but, provided the change was not for the worse, this would be no disadvantage, and it would of course be the care of the breeder to see that seed was selected from those plants alone which were of good type. Experiments to decide this question are now being conducted by the Department of Agriculture. It is time some attempt was made to ascertain the value of local selection of seed, since it is not too much to expect that by so doing new and perhaps more desirable types of leaf may be established.

The tobacco plant is self-fertilised, and in order to procure pure seed, cross pollination must be avoided. This is done by covering the flower heads in paper or muslin bags as soon as the buds appear, and before the flowers are opened. These bags must not be removed (except to examine the heads for worms, which get into the seed capsules and destroy the seed), until the seed capsules are ripening, when the selected seed heads can be cut off, labelled according to the type of plant, and stored until the following season. In all parts of the world, and with most crops grown by the farmer, local acclimatised seed gives better results than imported seed. Care, however, must of course be exercised.

In some instances the tobacco retains most of its finer characteristics for but a few years. In such cases it is advisable to frequently import fresh seed from the place where it reaches its highest excellence. Where Cuban tobacco is grown in the United States fresh seed is regularly imported from the Vuelta Abajo. The imported seed is not used directly for the planting of the main crop, but is sown for the production of a seed crop from which the main crop of the following year is grown. If produced year after year from local-grown seed, the Cuban plant will tend to lose its fine aroma and become like the seed-leaf varieties.

Classification of Tobaccos.—The classification of tobaccos according to the variety grown is of little value to the trade, because of the endless modifications produced by differ-

ences of soil and climate. The same variety grown on the same field for two different seasons may produce leaf that is adapted for entirely different purposes. The first season may be such that the leaf will be dry and thin, and only adapted for cigarettes, while the second season may grow a leaf that will be ideal for plug wrappers. The same plant will also produce several grades of leaf that will belong to more than one class; the lower leaves may be adapted for pipe smoking, the next for cigarettes, the middle leaves for plug wrappers, and the tips for a low grade of pipe tobacco, or if well ripened, for plug fillers. For this reason a classification quite distinct from the variety classification is adopted.

By a class is meant the purpose for which the tobacco is to be used, for cigars, for chewing, for cigarettes, or for the pipe. A type is based on the combination of certain qualities and properties in the leaf, as colour, strength, elasticity, flavour, body, aroma, or on certain characteristics produced by methods of curing, as air-cured, sun-cured, or flue-cured. One type may often be placed in more than one class, as is the case with the yellow tobaccos which fall into both the smoking and chewing classes. One district may produce several types, and one or more of these types may be identical with certain types produced in other districts. However, the various types are usually confined to certain districts where the conditions are favourable for the development of qualities that give the leaf a distinct characteristic.

A grade is a sub-division of a type based on the different degrees of quality, texture, size, aroma, etc. These sub-divisions are nearly endless, for a crop may be divided into say five groups on a division based on quality, then each of these groups may be divided into say three sub-groups on a second selection based on colour, and each sub-group may again be divided into a dozen grades according to length. Sumatra tobacco from the same farm may be divided into seventy-two grades.

The Characteristics of a Good Tobacco.—At one time any tobacco that would burn was considered fit for human consumption, but, along with the improvement and development of the plant, man's taste has been educated to the point of demanding certain essential characteristics in the tobacco intended for his use. There are many shades and variations in

Flower head protected from foreign pollen ("cross-fertilisation") by a Manila bag.

these characteristics depending on the trade catered for, because in their estimate of tobacco, as well as of wine, the best judges do not agree. However, certain points of excellence are always demanded.

If tobacco be intended for smoking, it must have the ability to hold fire and to burn evenly, smoothly and thoroughly. It must not char, that is, there must be no black line between the ash and the unburned portion of the tobacco. If it be in the form of a cigar, the ash should be white and solid, and not flake and fall over the clothing.

Tobacco must have flavour. It must be sweet and pleasant, and not too mild or too rank and strong. The flavour of the leaf must be agreeable and pleasant, for if the flavour is agreeable, the aroma of the burning tobacco is likely to be satisfactory. The aroma of a cigar is partly due to the volatilisation of the products of the sweat, and partly to the destruction of certain compounds by a process of dry distillation. This process takes place largely in the interior of the cigar and in the heated portion near the coal. This distillation and volatilisation create disagreeable odours as well as agreeable aroma, and a cigar can only be considered as good when the latter hides or subdues the former. This is true of cigarettes and pipe tobacco as well as of cigars, although in cigars the characteristics are more marked.

If a tobacco be intended for a plug wrapper, it must have style, elasticity, toughness and body. Nor must it be too large or too small for the size of the plug to be manufactured.

If intended for a cigar wrapper, the leaf must have style, and be elastic, thin in texture, finely grained, light and uniform in colour, and the stem and veins must be small and of the same colour as the leaf. The leaf should be as free from flavour as possible, as it is the portion that comes in contact with the mouth. The cigar wrapper can have much influence on the quality of the smoke for the reason that it is exposed to the air during combustion. The standard of excellence for wrappers is the Sumatra leaf, as the standard of quality in fillers is the Vuelta Abajo leaf.

If a tobacco be intended for chewing, it must have a certain toughness, so that it will hold together while being masticated, and not break up into small flakes in the mouth. Chewing tobacco must also be rich in flavour. A tobacco that has a high

absorptive capacity is eagerly sought after for this purpose, for the reason that large quantities of flavouring liquids and sauces are added. It is this ability to hold so large a quantity of flavouring sauces that gives to the White Burley its popularity.

Tobacco intended for pipe smoking and for cigarettes must be free from the gumminess so sought for in chewing tobaccos. This gumminess would interfere with the cutting or granulation of the leaf by machinery. The bright tobaccos are at the present time the fashion for cigarettes.

It is seldom that the desired standard of flavour is found in any one tobacco, and it becomes necessary to blend or mix different grades. Often this blending is done from the standpoint of economy, when a certain proportion of a perfect flavoured, but high-priced, leaf is used to give quality and character to a cheaper tobacco with all the requirements except the flavour. At other times the blending is conducted on the principle that, if but one tobacco be used, and at any time this particular tobacco becomes unobtainable, the substitution of an entirely different tobacco at such a time would ruin the established reputation of the brand by changing its character. From five to twenty-five different grades of leaf are blended together, and the substitution of a different grade for any one of them does not radically change the character of the blend.

The colour of the tobacco demanded is largely subject to fashion, and may change at any time, but the aroma sought for remains the same. Smokers are more and more demanding a certain standard of excellence in this particular. Brain workers, and those living a sedentary life, prefer a mild tobacco, while those living a rugged out-of-door life—as sailors—seek a strong, stimulating tobacco. The colour of a tobacco is not necessarily indicative of its strength. A mild tobacco may be thoroughly fermented until it is dark in colour, while a strong tobacco may have the fermentation cut short and be light in colour. A heavy dark leaf is, however, likely to be rich in nicotine and other similar products. The colour of the wrapper on a cigar is not a good feature by which to judge the strength and quality of the smoke. Cigars are often encased in all colours of wrappers when made, and sorted according to colour later. A cigar should be selected by the sense of smell; a tobacco that has a pleasant aroma will usually be agreeable if the burning qualities are also good.

Seed Beds, Chudleigh Farm, Marandellas.

Seed Beds, Uplands Estate, Marandellas.
Toughening the plants to the sun.

Uniformity in Tobacco Plants from self-fertilised seed
The two central rows of one strain ; adjoining rows from a different strain of the same variety.

Plants grown from (1) Heavy, (2) Medium and (3) Light Seed.
(U.S. Department of Agriculture.)

The palate and olfactories learn to accommodate themselves even to a poor smoke, and for this reason it is often a slow process to educate a nation to use a new good tobacco in preference to a badly-flavoured tobacco that has become established. A smoker may, because of his perverted taste, judge a bad tobacco to excel what is in truth a better tobacco.

THE SEED BED.—The tobacco seed is very small, and the reserve material for the nourishment of the young plant is soon exhausted. As a result, the young plant is forced to prepare its own food much sooner than is the case with most plants. Because of this, the young plant makes a very slow growth in its initial stages, so that soil and plant food must be placed in as favourable a condition as possible to aid the young plant through this critical period.

If all the seeds were fertile and capable of germination, one ounce of tobacco seed would be sufficient for three hundred thousand plants. Experience has shewn, however, that at least seventy-five per cent. of the seeds are sterile, and that many of the remainder will produce small and unthrifty plants, so that for every thirty thousand plants required it is necessary to allow one ounce of seed. Thirty thousand plants would be sufficient to set from four to seven acres of the Virginia type of tobacco and two acres of the Turkish and cigar tobaccos.

The plant bed for one ounce of seed should cover about ~~fifty~~ 200 square yards. Tobacco seed is not expensive when the area that a small amount will plant is considered, and it is far better to have too many plants than not to have enough or be forced to set weak plants. Planters should sow several times as many seed beds as would be necessary under ideal conditions, and allow short intervals of time to elapse between the sowings of the different beds. This assures a sufficient quantity of healthy plants, even if there be some losses. Then the time of planting varies with the different seasons, and it is an important matter to have plants of just the right size to set out when they are required. It may be taken as a general rule that a plant is ready for setting out when it attains a height of from six to eight inches.

Before sowing the seed, it is a good plan to test the germination. A hundred seeds are counted out and placed between two pieces of moist blotting paper. The paper is kept between

two plates and at a temperature of from seventy to eighty degrees for ten days, at the end of which time the percentage of good seed is determined by counting the number of seeds germinated. This will enable the planter to make up for any deficiency in germination by the use of a larger quantity of seed. It must be understood that the conditions in the soil are not so favourable to a high percentage of germination as is the blotting paper.

In choosing the location of the plant bed, there are several points to be considered. First, a good, rich, friable well-drained soil must be chosen and the site must be situate near a water supply.

Growers should give the site of the seed bed a thorough burning. The object of this is to destroy all insects, or their larvæ, that may be in the soil. In order to accomplish this burning, the soil is first laid with poles in order to keep the burning wood off the soil and admit the air. Upon these poles the wood is piled and the fire started on the leeward side that the progress may not be too rapid. A slow fire will convert all moisture in the surface soil to steam, and thus cook anything that may be in the soil. The fire is continued long enough to convert all the moisture in the first three or four inches of soil to steam. The use of steam instead of fire has been tried for the preparation of the plant bed and has proved very satisfactory. The steam does not destroy the combustible portions of the soil, while it cooks and destroys all seeds and insects. The steam is applied by running it through a pipe or hose, and confining it under an inverted wooden or metal case. A packing case that has been made steam tight will answer for this purpose. The use of steam is to be recommended where the planter has a traction engine at his disposal.

After the bed has been thoroughly burned, the soil is broken up to a depth of two or three inches, and all roots and other trash carefully removed. Care must be taken that the soil be not dug too deep, for this would bring to the surface weed seeds that have been buried too deep to be destroyed. Fertiliser is thoroughly worked into the soil. About three pounds of any good commercial fertiliser to each ten yards of the bed will answer the purpose. Nitrate of soda is the best fertiliser with which to give the plant a quick start and rapid growth, but this chemical should be used more sparingly than the other fertili-

Tobacco Seed Beds in Texas.

Seed Beds.

Seed Beds, Uplands Estate, Marandellas.

sers. Barn yard manure would be excellent were it not that it usually contains quantities of weed and grass seed that would neutralise all the good results of the burning.

The seed should be sown about sixty days before planting time. To sow the seed, mix it with ashes or fine meal, at the rate of one-fourth ounce of the seed to two quarts of the ashes or meal. The object of the ashes is to give greater bulk, thus enabling the planter to sow more evenly. The colour of the ashes or meal also informs the sower whether all portions of the ground have been sown with a sufficient quantity. After being sown the seed is not raked in, but the surface of the soil is lightly brushed with a broom. The sprinkling of the bed with water from an ordinary gardener's can will in itself be sufficient covering. Tobacco seed that has been buried too deep will not germinate.

The plant bed should be covered with a light cloth or muslin. This is stretched over a framework of boards or bricks that has been built around the border of the bed. Small sticks about six inches high are set up throughout the bed, to keep the canvas from touching the plants. This canvas will shelter the plants from the intense heat of the sun, and will at the same time retain during the night a portion of the heat of the day. It will also protect the plants from drying winds and insects. Where the cloth cannot be secured, a light covering of grass, or even of light brush, will serve to partially protect the bed from the sun and winds. This covering should be raised at least a foot off the bed, by means of a light framework.

Unusual care must be exercised in handling the plant bed, for it is a very easy matter to so injure the plants as to dwarf them throughout their life period. The soil should be kept moist, but not wet. If too much water be used the plants are not only likely to be smothered, but conditions are made favourable to the development of fungus diseases. Plants are better if not allowed to become too large before planting, as an over-large plant is more likely to grow lanky. During the last month, if the plants are not forward enough, it will pay to water them occasionally with liquid manure. For a week or more before planting, the canvas covering should be removed during the day to allow the plants to become toughened to the sun, and replaced at night in order to keep off moths. If the plants

appear to be growing too thickly, they should be thinned out; one good plant to each square inch is sufficient. This will give about thirteen hundred plants to the square yard.

In drawing the plants for transplanting, care must be taken to secure as much root as possible. The plant bed should be thoroughly soaked, so as to allow the roots to be drawn with little breakage. When the large plants are drawn out of the bed, the soil should be immediately watered, if not already done, in order to pack the earth around the roots of the remaining plants, which will have been disturbed by the operation. Never set out a plant that has been damaged. As soon as the plants have been drawn they should be placed in a basket, with the roots downward. The top of the basket must be covered with a cloth, and the basket put in a cool place until the plants are set out. Some useful advice in regard to dealing with insect pests in the seed bed will be found in Chapter VII.

Preparation of the Land.—Ninety to one hundred days after it is set in the field, the tobacco plant should have reached maturity. In order to properly accomplish this result, the soil must be well tilled, so as to allow the roots to rapidly pursue their search for nourishment. The soil must be in a condition to admit air to the rootlets, and also to the beneficial nitrifying bacteria in the soil, and at the same time it must have the ability to hold sufficient moisture for the needs of the crop. This condition can be reached only by a thorough preparation of the soil before planting time. The fibrous rooted tobacco plant seeks its food near the surface, but, because of this fact, the sub-soil should not be neglected, for on the condition of the sub-soil depends largely the moisture content of the surface soil.

Immediately after a crop is harvested, the grower should turn his attention to preparing his land for the next crop. The stubble, if allowed to remain in the land, weakens the soil and harbours injurious insects. It is, therefore, of the utmost importance that the stalks should be taken out and burnt as soon after the crop is reaped as possible. The proper preparation of the land for the tobacco crop is an item which is frequently treated with too little care. It is, in reality, the most important cultivation the crop ever gets. Thorough preparation until the land is soft and mellow is the rule for all crops, but especially is this true of tobacco. A good crop of tobacco is very rarely harvested from poorly prepared land. The

Clearing land for Tobacco, Chudleigh Farm, Marandellas.

land should be ploughed just before the planting season, and the breaking of the ground should be thorough and at least six inches deep. Double-cutting with a disc harrow just before the time of laying off the rows, pulverises the land more thoroughly than re-ploughing, and is, therefore, preferable. It has been found profitable to lay off the tobacco rows only a few days before the transplanting season, for the land is likely to become foul with weeds and grass, unless it is constantly cultivated. It is possible the land may be full of insects, and an excellent way of cleaning it is to keep flocks of turkeys and fowls, where they can follow the implements, and pick up the caterpillars and grasshoppers. It is cheaper to fight cutworms and grasshoppers before planting time, than afterwards. In preparing new ground for tobacco, it is preferable to turn over the land while the grass is green. In good time before planting time work the land up into garden tilth, and keep it so by harrowing, as the condition of the soil will permit. Many crops are checked in their growth by the fact that the soils do not contain sufficient moisture, which would not be the case if the rainfall had been conserved by careful tillage. Do not be deceived by the thought that surface cultivation causes a loss of moisture during dry weather; it has the opposite effect.

Planting.—This is a matter of great importance, and requires careful attention. If the plants are not well planted, the growth will be irregular. Very great care must be taken not to break or bruise the plants in drawing them from the bed, or in conveying them to the field. The holes must not be deeper than the plants are long, and care must be taken to see that the earth is well put to the roots. There are two methods of growing the plants: one is known as level cultivation, and the other as hill or ridge cultivation. With the former system, the field is marked off into rows, 3 to $3\frac{1}{2}$ feet apart, and the plants set at the distance of 3 feet in the rows. If it is desired to use the horse cultivator in both directions, the field is marked both ways, so that the plants will "check row." With hill planting, the field is thrown up in ridges, $3\frac{1}{2}$ feet apart, and the tobacco set on the tops of these ridges. The ridges are formed with a small plough, or with a horse cultivator, using the wing adjustment.

Each system is followed in Rhodesia, but hill planting is recommended as the more serviceable. Ridging undoubtedly

saves time and labour, for when the rains arrive all hands can assist in the planting, instead of, as in the case of level cultivation, several boys being detailed off with strings to lay the field out. A further recommendation in regard to ridging is that if the plants fail to get a stand at the first planting, there is no difficulty in replanting the field, the rows being clearly defined. Ridging is also a great assistance in cultivating, while if the soil has a tendency to become too wet, ridging will drain it better. With ridging, the fertiliser can be applied with a drill at the time the ridges are thrown up, thereby effecting a considerable saving in time and labour. It is considered better for the fertiliser to be applied before planting out, as the plants are thus able to get a start at once.

In several instances we have seen plants transplanted before the rains arrived, and covered with brushwood or paper, as a protection from the fierce rays of the sun, thrive well. During the 1912-3 season Mr. W. H. Brown, of Arlington, Salisbury, adopted this process, the plants which were planted about a week before the rains arrived doing well. About half a pint of water was poured around each plant, and the soil, upon examination four or five days later, was found to be quite moist.

The distances of 3 and 3½ feet hold true only for the Virginia type of tobacco generally grown in Rhodesia. Most of the cigar varieties are planted much closer together in the row. The Cuban and Sumatra tobaccos are but a foot to fourteen inches apart in the row. Some of the stronger growing varieties are planted from eighteen inches to two and a half feet apart. The distance depends on the size of the plants. If a cigar tobacco be given too much room, the leaf will become too large and coarse for cigar purposes. Sumatra tobacco when first grown in Florida was very nearly a failure, for the reason that it was set too far apart and became coarse. In Sumatra, where hand labour alone is used, the plants are placed two feet apart in each direction; but Sumatra has a heavy rainfall and a tropical climate, so that the plants grow very rapidly and are fine in texture. This distance might not do for localities where the condition for a rapid growth was less favourable. In America, the rows are always at least from 3 to 3½ feet apart, for the reason that most of the work is done by means of horse cultivators. In a new locality growers must determine the distance by experiments.

Planting out Tobacco, Chudleigh Farm, Marandellas.

If the day be cloudy, planting may be done at any time, but if the day be hot and dry, the planting should be left until the last half of the afternoon, so as to give the plants an opportunity to recover and establish themselves during the coolness of the night. Where the planting is done by hand, the plants are dropped along the row at regular intervals by a native. Immediately after the plant distributor there follows a native, who, with a round stick about six inches in length, makes a hole, and then inserts the plant into the hole, and, while holding it firmly with one hand, presses the earth firmly round the roots with the stick. The surface of the soil is then rapidly smoothed over, and left in as loose a condition as possible. When the soil is dry or the weather unfavourable, one person carries a pail of water, and either goes just before the planter and pours a little water into the hole or follows close after, and places the water in a small hole made beside the plant. If this additional hole is made, it must be covered up as soon as the water soaks in to prevent evaporation. Even if the soil appear to be sufficiently moist, the use of water in planting will give good results, for the reason that it settles the earth firmly around the roots of the young plant, and thus permits it to start growth at once. A European and a native will plant about 5,000 plants a day, and one extra person can do the watering for that number of plants, while a fourth person with a wagon can haul the water for a large number of planters. There are various methods of marking off the rows, the most common of which is by wire guide lines, marked off every three feet. Some growers use a mealie planter, the wheels of which, being three feet apart, in travelling over the ground leave a line sufficiently well defined to act as a guide to natives, who dib a hole on it every three feet. The contrivance illustrated in the accompanying photo is claimed by the constructor to work satisfactorily, and to effect a saving of labour.

In Cuba the plants are not set in holes, but a small furrow is made with a shovel cultivator or a small plough. The plants are then rapidly set by being placed in this furrow and a handful of earth drawn to each. The soil is then levelled up with a hoe. This proves to be a speedy method. The furrows should not be made much ahead of the planter, and must be filled up at once so as to avoid evaporation.

In America transplanting machines are chiefly used, and these implements have been tried in Rhodesia, but they have not yet attained any popularity. These machines set the plants at the desired distances and water them at the one operation. The machine will also, if desired, place a small quantity of fertiliser with each plant. Three persons are required to handle such a machine—one to drive the two horses, and the others to feed the machine with the plants. Five acres of ordinary tobacco may be thus planted in a day.

Cultivation.—The soil is supposedly in fine condition and tilth when the plants are set, and the aim of cultivation should be to keep it in that condition. The tobacco plant is largely a surface feeder, and its roots do not penetrate deeply in the soil. For this reason, shallow cultivation only should be used, so as not to cut off the roots and check the growth of the plant. No set number of times can be given for the cultivation of the field, but it should be done whenever the soil begins to harden or crust over.

As soon as the plants have taken root, so that there is no danger of killing or damaging them in any way by working, cultivation should commence. Cultivation is too often neglected in this country, but it is a matter of primary importance. Whether there are any weeds or not, cultivation must be done as early as the condition of the plants will permit. Cultivation is not merely for the purpose of killing the grass, but also for the admission of the air necessary to the roots of the plants as well as to the nitrifying bacteria. After wet weather, cultivation hastens the drying out of the soil, and in dry weather, cultivation, by the creation of an earth mulch, prevents excessive evaporation.

With level cultivation, when the plants have started to grow, the first cultivation should be done with a small horse cultivator, which should work up one side of the row and down the other side of the same row, as near the plants as possible without damaging them. Some growers in this country work the cultivator down the centre of the row only, but this method is not to be recommended, as the earth in the vicinity of the plants is not stirred. Subsequent cultivation should take place every week or ten days, as the condition of the land requires, but a cultivator with larger tines should be used from now until the last cultivation, when a broad-winged shovel plough should

Tobacco Marker at work.

Tobacco Marker constructed and used by Mr. S. L. Nalty at Chudleigh Farm, Marandellas. With this contrivance the guide line has only to be shifted every four lines, instead of every line as with the linked wire. Mr. Nalty claims that a considerable saving of time is effected by using this Marker.

be run down the centre of the rows, in order to throw the earth round the plants. A rapid growth from the time of planting until the ripening period will give that fine, even texture so desirable in high-class tobacco. When the plant is ready to be topped, cultivation should cease, for any further stirring of the soil will tend to induce an injurious second growth.

After Treatment: Topping.—The tobacco plant has a tendency to the production of seed, and for the reason that the seed is formed at the expense of the leaf, the blossom or terminal bud must be removed, and with the blossom must be removed all the leaves in excess of those that the plant can properly develop and ripen. Expert tobacco men do not count the number of leaves to be left on a plant, but through long practice are able to top the plant to the right number of leaves for its capacity. The number of leaves that a crop will average will depend largely on the season; one year but ten leaves may be left to a plant, and the following season an average of sixteen leaves may be left, and the product be of equal value both seasons. The removal of the terminal bud produces a great change in the plant, by increasing the surface and thickening the leaf. The operation also causes an increase of the protein compounds and nicotine in the leaf as well as hastening the process of ripening. If the plant is topped too low there will be a rapid thickening and curling of the leaf; if this occurs some of the suckers should be allowed to grow and check this tendency. It is a difficult matter before the operation to say how tobacco should be topped; in fact, it is difficult then, as so much depends on the season. However, in Rhodesia, with the demand for bright thin tobacco, it may be taken as a general guide that it is better to top too high than too low. Still, the aim should be to produce a tobacco with some body or oil in it, as thin lifeless tobacco has no weight. We would recommend that tobacco grown on light sandy soil, or tobacco that has the appearance of being light or of poor growth, should be topped as soon as the button (or seed head) appears. Heavy tobacco should be allowed to blossom, and should be topped high, for this will have a tendency to make it thin and light.

Priming.—At the time of topping, many growers pull off the lower leaves of the plant, and this operation is known as priming. These leaves are usually small, thin and very dirty, and would not produce saleable tobacco even if left to mature.

The exponents of priming maintain that these leaves, being useless, should not be allowed to appropriate the sap that would otherwise go to the other leaves. It is contended that these "sand lugs" furnish a harbour for insects, and also that the removal of these leaves will leave more room for the use of the hoe. Growers are advised to remove the lower leaves.

Suckering.—As soon as the plant is topped, or even before, small shoots or suckers start out from the axils of all the leaves. If these suckers be allowed to grow, they will greatly lessen the amount of tobacco produced and also injure the quality. As soon as the suckers appear they must be broken off. This will have to be repeated at least once a week. The work can easily be done by children, but care must be exercised that the remaining leaves are not broken off or injured.

Ripening.—This is hastened by the topping and suckering operations. The remaining leaves are filled with an abnormal accumulation of organic compounds that would have been used for the development of seed and other leaves had the tobacco plant been allowed to mature normally. The plant at this stage largely increases its percentage of acids, nicotine and protein compounds. A ripe leaf has a rough feeling to the touch, and when folded between the fingers will easily crack. There will also be a change in colour from a dark to lighter shades of green, and the appearance of yellow spots. This indicates the maturity of the leaves, and the translocation of material from the older portions to the less mature leaves of the plant. A brownish colour may also appear around the borders of the leaf.

Harvesting.—When the proper stage of ripeness has been reached, the time has arrived for the harvest. All portions of the tobacco plant do not ripen at the same time, and, because of this fact, two different methods of harvesting have been developed. In the one system the whole plant is harvested on the stalk when the middle leaves of the plant are mature, while in the other system each leaf is primed off as it becomes ripe. The first system is accomplished with the minimum of labour, although it will not produce so large a percentage of properly ripened tobacco as the second system, for when the middle leaves are at the proper stage of ripeness, the lower leaves are over-ripe, and the top leaves still green. The advocates of the stalk cutting or whole plant system maintain that a

Planting out Tobacco at Mr. C. B. St. Gwynne's Farm, Nyamandhlovu.

Cultivating Tobacco at Chudleigh Farm, Marandellas.

large percentage of the material in the stalk is transferred from the stalk to the leaf during the process of curing, and this claim seems to be substantiated by experience. This system is the one largely used for the bulk of the tobacco in America, but the bright tobacco grown in Rhodesia is usually harvested by the single leaf method. In some places a combination of the two methods is adopted, the lower leaves being harvested singly as they ripen and the upper half of the plant taken off with the stalk. Where the leaves are primed they are at once placed in baskets and hauled to the curing barn.

There appears to be no better way of stringing leaves than that at present in use in Rhodesia. This can best be explained by practical demonstration, but the general principle is that one length of string is used and the hands of leaves looped on alternate sides of the stick. The stick is then hung on the tier poles in the curing barn. The hanging of the leaf does not appear to receive the attention it deserves. Many growers hang the leaf too thickly, and also string it at uneven distances on the stick. In the former case the leaf does not have a fair chance of drying, while if the bunches are hung unevenly the current of air is unequally distributed. The "hands" should not consist of more than three leaves, and the sticks should be far enough above each other so that when the tobacco is hung there will be sufficient ventilation space between the tips of the stalks or leaves of the top tier and the leaves of the tier below, so that each "hand" will get the same amount of ventilation.

Bright sunny days should be chosen for the time of reaping. The acidity of the leaves is less on a warm sunny day than upon a cool or cloudy day, and is also less in the evening than in the morning. On a bright day the processes of metabolism are promoted, and the respiration stimulated, so that at the end of such a day the leaf will have more of the desirable products and less of the undesirable by-products than at other times.

The plant should be slightly wilted before being hauled to the curing barn, as this will prevent breakage and hasten the commencement of the curing process.

Leaves, if left long exposed to the sun, will become sunburned, that is, the heat of the sun will kill the plant cells and at the same time destroy the enzymes that bring about fermen-

tation; this being the case, no further life changes or processes of fermentation can take place, and, with the exception of the drying of the leaf by the evaporation of moisture, no improvement will take place. The greenness of a sunburned leaf will always remain and reduce its value. Sunburned leaves will carbonise and not burn satisfactorily.

Water in Relation to the Tobacco Crop.—Upon the percentage of water in the soil depend largely the colour and texture of the leaf. The value of many tobacco soils is not based so largely on their fertility as it is on the soil's ability to hold greater or less proportions of moisture, to drain off rapidly the surplus water in times of plenty, and, by capillary action, to draw up water from below in times of drought.

Water has many functions and offices in the development of a plant. Water loosens the soil, and allows the delicate rootlets to continue their search for food; it permits the beneficial nitrifying bacteria of the soil to exercise their functions; aided by the plant juices, it dissolves and makes available the plant food in the soil; it transports the plant food from cell to cell, and from one portion of the plant to another; by evaporation it cools the plant, and prevents the death of the delicate protoplasm, through the action of the blistering sun; and more than this, water acted upon by the energy of the sun, combines with the carbon of the air and becomes the chief food of the plant, forming the starch, the sugar, the cellulose, and also largely the gums, oils, and acids that together make up at least 80 per cent. of the weight of the fire-dried plant. Water, by its sufficient presence in the curing plant, permits the development and action of the oxidising enzymes, and of the different chemical changes that take place.

Water in excess prevents the action of the nitrifying bacteria, and favours the action of the de-nitrifying bacteria, smothers the roots by preventing the movement of air in the soil, and, by evaporation from the surface of the soil, cools the earth to the point where rapid plant growth cannot take place. Heavy rains also wash out of the soil a portion of the soluble food materials.

Heavy rains during the ripening of the tobacco plant wash out the desirable gums and oils, and render the leaf thin, papery, and devoid of fine aroma. Rainy cold weather tends to

Stringing Tobacco on sticks, to be flue cured.—America.

the production of acids in the leaf, and these acids are detrimental to the action of the oxidising enzymes to which the development of aroma is largely due. An undue degree of humidity is also favourable to the development of plant diseases, and to the growth of moulds and rots in the curing and cured tobacco. On the other hand, if there be a great scarcity of rainfall, even if the plant be kept growing by the moisture in the soil, there will be an absence of the materials that produce a favourable fermentation. Heavy dews on the plant during the ripening period are greatly desired, for they aid in the production of gums, resins, oils, and other products that are necessary to the production of a good, sweet and finely aromatic tobacco. To produce a fine textured leaf means that the plant must be kept growing from start to finish, and to do this, the plant must be supplied with water in sufficient quantities.

As indicated in the previous chapter, it is not generally deemed advisable in Rhodesia to grow the crop entirely by means of artificially supplied water, but yet irrigation may be of considerable value in getting the plants started in the field before the rains arrive. The crop will thus mature earlier, and permit of longer use being made of each curing barn, a matter of no little importance.

CHAPTER III.

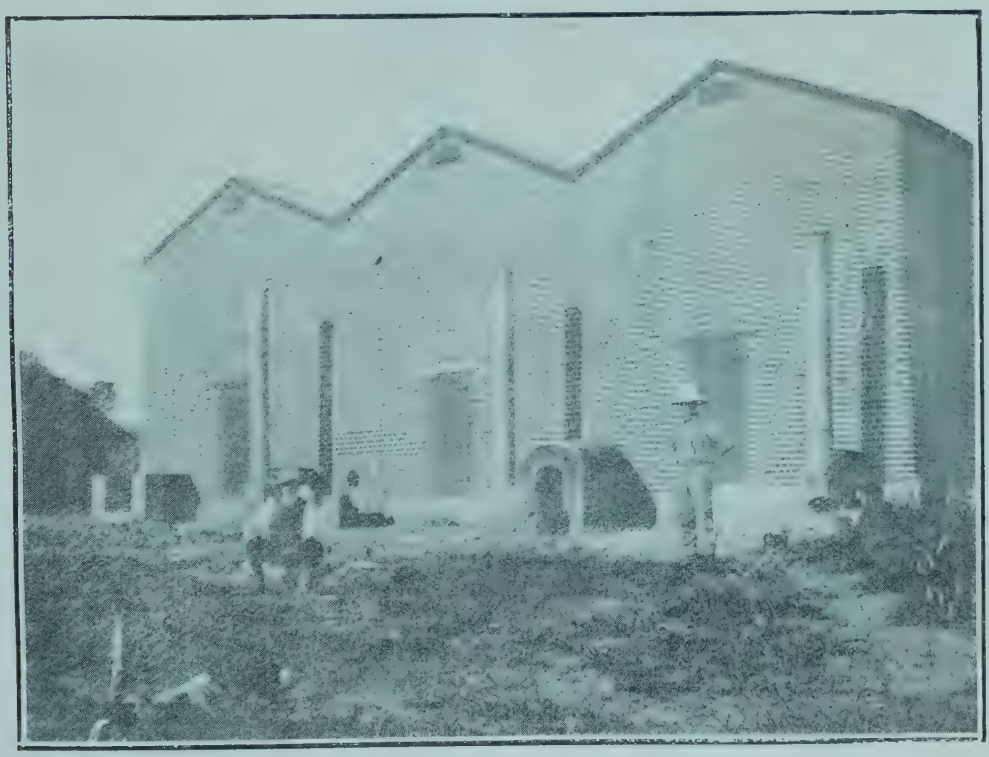
The Principles of Curing.—Flue Curing.—Flue Curing Temperatures.—Sun Curing.—Air Curing.—Curing Cigar Leaf.—Fermentation of Cigar Leaf.—Bulk Fermentation.—Ageing.—Some of the Chemistry of Curing and Fermentation.—Buildings: The Curing Barn.—Plans and Specifications for Flue-Curing Barns. — Other Barns: A Florida Barn.—A Pennsylvania Barn.—Packing Houses.—Steam Chest.—Baling.

The Principles of Curing.—Curing is not merely drying, but is a chemical and fermentative process, the exact changes and reactions of which are not fully understood. The quality of a tobacco is made in its growth; curing but fixes or further develops those qualities. A badly grown tobacco cannot be made into a high-class product by any process of curing, although by skill in handling it may have latent or slightly developed good qualities brought out and emphasised, and it may also have its bad points partially suppressed. A very fine tobacco may be absolutely ruined by lack of skill in the curing process.

The process may be said to commence the moment the plant is cut, and to continue until no further change takes place in the leaf. Commonly this curing process is divided into several stages, the first one of which is allowed to appropriate the word "curing." The second stage is known as the "fermentation" or "sweat," and there may also be a third stage which is known as "ageing." This third stage is but a mild continuation of the process of fermentation.

The theory that bacteria are largely instrumental in producing the many changes of the different stages of the curing process has been advanced by a number of scientists. It was even, for a time, supposed that bacteria produced on the aromatic Vuelta Abajo could be transferred to other tobacco, and that the fermentative processes thereby initiated would develop an aroma equal to that of the Cuban tobacco. From this it was reasoned that all distinctions of section, soil, and

Flue Curing Barns, Lochard.



Flue Curing Barns, Borrowdale Estate.

climate would be broken down, and all that would be necessary for the production of fine tobacco would be to select a locality where the soil was fertile and labour cheap, and inoculate the tobacco with the best aroma-producing bacteria. However, no startling commercial changes based on this theory have as yet taken place.

Dr. Loew, of the United States Department of Agriculture, has shewn that not only are bacteria not responsible for the fermentation of tobacco, but that the fermenting leaves are destructive of bacterial life. By a series of experiments, he has demonstrated that the chemical changes that take place in the curing and fermentation of tobacco are due to the presence of oxidising enzymes. Enzymes are closely related to the soluble ferments. One of these ferments, diastase, takes a prominent part in the fermentation of malt, and will change two thousand parts of starch into sugar for each part of itself. The oxidising ferments have the power of taking oxygen from the air, and supplying it to the contents of the plant cells, thus causing the splitting up of existing chemical forms, and the creation of new products. In this process the enzymes suffer but little loss of themselves, for they merely act as agents, and take with one hand what they give with the other. Platinum black has a somewhat similar power, as is often shewn in the chemical laboratory. An example has been given of a somewhat analogous action that takes place when a weather-exposed board decays more rapidly in the proximity of a rusty nail. In this case the wood, assisted by the iron oxide, is enabled to combine with the oxygen more rapidly than it would if left to itself.

Enzymes are highly complex protein forms, and make up a part of the protoplasm of the plant. They are easily destroyed or changed into other protein forms by much heat, or by the too rapid loss of their moisture. When the plant is slowing starving to death, as it is when it is cut and allowed slowly to dry, there is a rapid formation of these enzymes, which separate themselves from the protoplasm, and push out through the plant in search of food for the dying plant cells. Having thus distributed themselves, the enzymes are in position to become again soluble, and take up the work of fermentation whenever the conditions become favourable, as they do in the fermentation pile. If the leaf be killed by heat or by rapid drying, the enzymes will have no opportunity to escape from the proto-

plasm, but will become entangled with the insoluble protein, so that later, when the leaf is moistened for the fermentation, the process will be a partial or total failure, for these enzymes are only active when in solution.

To repeat, the chemical changes in the leaf which develop the aroma, as well as eliminate undesirable products, are due to certain enzymes. These changes take place during the second stage of the curing process, which is commonly called the fermentation or the sweat. But these enzymes are largely developed in the first stage of curing, and unless this first stage be properly conducted, the enzymes will not exist in large quantities, or in available forms, and the products developed in the fermentation will be largely disappointing. With this fact clearly in mind, the reasons for certain steps in the curing will be better understood.

Fine aroma is considered of greater importance in cigar leaf than in other forms of tobacco, and for that reason greater attention is given to its fermentation, and more care is exercised in its preliminary curing, so as to prepare it for fermentation. All tobaccos go through a fermentation, whether such a stage be regarded as a part of the routine or not. In some tobaccos, where other characteristics than aroma are chiefly sought, the curing process may be such as to destroy the enzymes and the leaf's power of fermentation. This is largely the case with the bright yellow tobaccos, for the intense heat and rapid curing of the process designed for the colour, destroys most of the enzymes. But even in this case a small amount of the enzymes must survive, for the cured leaf goes through a slight fermentation known as the "May sweat." It is in this sweat that most of the aroma that this type of tobacco has is developed. If this tobacco be placed in a moist condition and bulked, as are the cigar tobaccos, it will not ferment, but will decay. The tobacco grower will say that the texture of the leaf has been destroyed by the heat; it would be more accurate for him to say that the oxidising enzymes have been destroyed.

Flue Curing.—This is a process where artificial heat is used for curing tobacco, but open fires are not permitted, and the smoke does not come in contact with the tobacco. The fires, which are of wood, are in small brick furnaces, in some cases on the outside of the building, and in others inside,

and the heat is carried through the building and under the tobacco by means of large sheet-iron pipes or flues. This is the system used for the curing of the yellow tobacco of the Virginia type, which has become so popular for pipe smoking, cigarettes and for the plug wrappers of chewing tobacco. The feature sought in the yellow tobacco is the colour, and the aim is to produce this and yet damage the texture and elasticity of the leaves as little as possible. In the dry climate of South Africa it has become evident that heat also has a value in the curing of dark tobacco, if for no other reason than to remove the greenness so common in much of the air-cured leaf.

No other type of tobacco or other system of curing requires as much skill in its handling. A little misjudgment in maintaining a certain temperature for too long or too short a time will largely lessen the value of the product. Slight shades in colour may mean large differences in the selling price. No set rules can be given for the handling of this process, as much depends on the condition of the leaf when placed in the barn, and on the weather conditions during the curing period. The barn will be described later, but it may be said here that the barn must not be so large that it cannot be filled in one day, for the tobacco in any one barn should not be in different stages of greenness. The barn must also be in a locality protected from the winds, for a strong wind will cause the temperature to be much lower on the windward side of the barn than elsewhere, and thus prevent an even curing of the contents. The ventilation of the barn must also be under perfect control. It is perhaps needless to say that, where so much heat is used, a thermometer is a necessity. This should be hung in the centre of the barn, and in such a position that it may be easily read from the door.

Fires should be started immediately the barn is filled, for fermentation commences as soon as the tobacco is reaped, and the more quickly it is cured the better. As soon as the barn is full, start a slow fire in the furnace, and slowly bring the barn up to the temperature required.

Where the leaf is ripe and sappy, and has been grown on a sandy soil, yellowing is not difficult, but where the leaf has made a slow growth and is leathery, it often refuses to colour. In the latter case, increase the humidity of the room

by letting in steam, or by sprinkling water on the flues, until the air feels moist. The yellowing stage will require from twelve to thirty-six hours, according to the character of the leaf. Where more than the latter period is required, it is almost impossible to secure really bright tobacco, and the attempt may be abandoned. If the building is required, the obstinate leaf may be shifted into another building and left to air-cure; but if it is left in the flue-barn, a slow fire should be kept up for several days, and the temperature of the room maintained from 80 to 100 degrees. So long as the temperature does not run over a hundred, the fire will not require much attention. These remarks, it must be understood, apply to tobacco that will not yellow and does not apply to bright leaf.

The second stage of flue-curing is that of fixing the colour. As soon as the leaf has turned to a greenish yellow colour, commence to gradually increase the temperature. If the leaf is permitted to become a bright yellow before the temperature increases, there is danger of it becoming dark and badly sponged before the colour is fixed. The fixing of the colour is the difficult stage of flue-curing, for if the temperature be too low, and the room humid, the leaf will "sponge." By sponging is meant that the leaf develops nasty porous brown patches. Sponging is checked or prevented by opening the ventilators; but the heat must be maintained. If the novice increases the heat in an attempt to carry off this moisture, the tobacco sweats still more until a point is reached where the surface of the leaf is cooked and it begins to "blotch." The term blotching is used to describe the smooth, hard reddish-brown spots that appear on the leaf as the result of high temperatures. When the leaf blotches, the beginner is frightened, and rapidly reduces his temperature, with the result that the warm leaf still sweats, and sponging becomes general throughout the barn. The correct practice is to keep the leaf sweating, but to so regulate the temperature and ventilation that the moisture is carried off the leaf as rapidly as it appears, and at the same time to limit the ventilation sufficiently to prevent the surface cells of the leaf from being dried out faster than they can draw moisture from the interior of the leaf. If these surface cells become dry at this stage, the moisture cannot escape rapidly through them, but remains in the leaf, and at the slightly higher temperatures to follow results in blotching. The leaf

Tobacco at Tobacco Plantations Company's Farm, Sublime, Rhodesia.

must sweat, but cannot do so in a very dry air, but if at the same time the air is over humid, oxidisation is rapid, and the leaf sponges. To state in another way, sponging is the result of moisture on the surface of the warm leaf; blotching is caused by the failure of the moisture to escape and the cooking of that portion of the leaf by high temperatures, and is often induced by the drying out of the epidermis of the leaf at any of the previous temperatures. As already stated, sponging is prevented by ventilation and by the slow increase of temperatures; blotching is prevented by the same means, but, in sponging, the greater the ventilation the less the danger; in blotching, the greater the drying due to ventilation the greater the danger. To prevent both it is necessary to strike a happy mean, which is not difficult where all the leaf in the barn is of the same degree of ripeness. Where the leaf in the barn varies regarding the degree of ripeness it will not undergo the same changes at the same time, and it is necessary to regulate the heat and ventilation according to the requirements of what appears to be the most valuable class in the barn.

To go back to the first or yellowing stage. As we have before stated, a certain amount of humidity is necessary during the yellowing stage, for if the moisture escapes rapidly from the leaf all action within the cells ceases and the chlorophyl (green colouring matter) of the leaf is not destroyed as it is when the leaf remains alive and slowly starves to death. This destruction of chlorophyl by the dying leaf is noticeable in all leaves, except those that are rapidly killed by excessively high or low temperatures, dry winds, etc. In an ordinary air-curing barn the same yellowing takes places where the weather conditions are favourable, but in a flue barn the change is much more rapid, and under the influence of heat the leaf yellows as much in a day as it would in the air barn in a week. In the air barn, however, if the weather is cold or dry only a portion of the chlorophyl disappears, and the leaf is left with a nasty green tinge. Now, it is evident that under ideal conditions any leaf would become as yellow in an air-curing barn as in a flue-curing barn, but those ideal conditions seldom exist, for if the weather is excessively moist each portion of the leaf oxidises as rapidly as the chlorophyl disappears, and we never observe the yellowing stage.

Now, in the yellowing stage in the flue-curing barn, the novice remembers all that he has heard about excessive moisture in the barn inducing sponging, and in an effort to keep ahead of his tobacco, he starts full ventilation too soon, that is, before the leaf has yellowed, and ends up by so drying the leaf that there can be no change, and it therefore remains green. This is the same effect as produced in an air-curing barn or in sun-curing by drying winds.

To return to the fixing of the colour. After the temperature has been slowly increasing for from twelve to thirty hours, and the leaf has lost the greater portion of its moisture, it will begin to dry at the tips and around the edges. Where this drying is general throughout the barn, the second stage may be regarded as at an end. The temperature at this point should be about 120 deg. F.

The third stage simply consists of the rapid drying out of the leaf, and is commonly calling "the killing of the leaf." The temperature is increased from 120 deg. to 160 deg. F., at the rate of four or five degrees an hour, and is held at the higher temperature until the midrib is perfectly dry and brittle. During this stage the ventilators are partially open, but inasmuch as less moisture is escaping than during the sweating stage, and because of the great draught due to the heat, they are not fully open. Wide-open ventilators mean a large consumption of fuel.

As soon as the drying is finished the fires are drawn. The leaf may then be rendered pliable by running steam into the room, after which it is taken down and removed to the packing house. In the packing house it may be bulked on the curing sticks and handled at a later date. In moistening the hanging leaf only use enough steam to render the body of the leaf pliable, while the midrib remains somewhat brittle. Excessive moisture will result in mould and in the darkening of the leaf.

During the curing process, large timber will be found to give a more even fire and less changeable temperature than small sticks, and the bulk of the wood should be heavy. Small sticks are needed to put with the large wood whenever the fire is low. When the fire is to be left for some time, and it is feared that the temperature will vary, it is safer to so arrange it that it will become less instead of greater, for the brick walls of the buildings will give up sufficient heat to compensate for a

diminishing fire. A large bed of coals will maintain an even temperature for a couple of hours. Avoid rapid changes in temperature, and even where the temperature is found to have dropped below the desired point, do not attempt to force it up rapidly by means of a large fire, for the result will be excessive temperatures in a few minutes, and the ruination of the tobacco. When it is intended to open the ventilators, slightly increase the fire before doing so, and thus prevent a falling temperature. At sundown additional firing is necessary to maintain the day heat, and at sunrise the fire should be slightly reduced unless an increased temperature is desired.

The first, and perhaps the most essential, point in connection with flue-curing is to have all the tobacco in any one barn uniform in ripeness and in body, and all as ripe as possible.

The following temperatures are given as a guide to the beginner with no experience in flue-curing tobacco, and it is hoped that with a few changes, to meet varying atmospheric conditions, they will give satisfactory results. Moisture has usually to be supplied in the dry climate of Rhodesia, by the application of steam, or by laying wet sacks on the floor of the barn. This should be done when the fires are started, and should be kept up for six or eight hours, when it may be discontinued, the tobacco by this time having sufficient moisture.

Ripe Thin Tobacco.—95 deg. for 7 hours, 100 deg. for 8 hours, 105 deg. for 12 hours, 110 deg. for 6 hours, 115 deg. for 6 hours, 120 deg. for 5 hours, 125 deg. for 4 hours, 130 deg. for 8 hours, 135 deg. for 6 hours, 140 deg. for 1½ hours, 145 deg. for 1½ hours, 150 deg. for 1½ hours, 155 deg. for 1½ hours, 160 deg. for 3 hours, 165 deg. to 180 deg. until cured.

Ripe Heavy Tobacco.—95 deg. for 8 hours, 100 deg. for 9 to 10 hours, 105 deg. for 14 hours, 110 deg. for 8 hours, 115 deg. for 6 hours, 120 deg. for 7 hours, 125 deg. for 5 hours, 130 deg. for 8 hours, 135 deg. for 6 hours. Then proceed as in first receipt.

Unripe (Green) Tobacco.—Tobacco should never be put into the barn green unless it cannot be avoided. The following are the temperatures suggested with such leaf :—90 deg. for 6 hours, 95 deg. for 8 hours, 100 deg. for 14 to 16 hours, 110 deg.

until the last leaf is yellow, and then proceed as in first receipt. The atmosphere being very dry, considerable moisture should be put into the barn at the start, to ensure the leaf not drying too soon.

Sun Curing.—With heavy tobacco that will not flue cure properly, it has been found profitable in Rhodesia to sun cure it, especially when there is no danger of rain. This is done by sweating the tobacco under grass for 18 to 24 hours before hanging it in the sun. The tobacco should in the first place be strung on sticks and placed on a bedding of grass two sticks deep. A thin layer of grass should be placed on top of the tobacco, which should be allowed to yellow, care being taken to prevent it heating too much, or the tobacco will turn black in the pile. When the leaf is yellow, it should be hung on scaffolds or racks in the sun and covered at night with grass or bucksails to keep the dew off. If the tobacco cures green, it is, however, advisable to allow the dew to get to it for two or three nights. The sun will then remove the greenness and bleach the tobacco. Too much dew must not be given.

Air Curing.—Any tobacco may be air cured, but, of course, where the yellow colour is sought, heat must be applied. With air curing it is not necessary to sweat the tobacco. A scaffold, thatched and covered in at the sides, should be made, into which the leaves, after being strung on sticks in the usual way, are placed, and the tobacco left until it is cured.

Air curing is an easy way of treating tobacco, but it takes a long time to dry the mid-ribs, and a barn will be found very useful to complete the drying process.

Curing Cigar Leaf.—Most types of cigar leaf are cured on the stalk; but with certain types, as the Sumatra, when the plants ripen unevenly, and where a slight difference in the leaf intended for wrappers makes a large difference in the value, it is necessary to harvest the crop by the single leaf method. In this case the leaves are taken to the curing shed and thirty or forty are threaded on a string, each end of which is fastened to a lath, 4 feet to 6 feet long by $\frac{3}{4}$ inch thick. The leaves are placed on the string face to face and back to back to prevent curling; the laths are put closely in the bottom tiers, where they may remain from forty-eight to

Broad Leaved Plants.

Narrow Leaved Plants.

seventy-two hours, according to the moisture in the shed, then carried up and adjusted on the upper tiers, the laths put about 6 inches apart. The drying of the leaf in the curing shed is entirely governed by the conditions of the weather. However, in a general way, if the shed be filled with green tobacco, and the weather be hot and dry, the shed should be tightly closed for about three days, by which time the tobacco will turn yellow. The shed should then be opened at night, and kept closed during the day. This is done to prevent rapid curing, which gives a green and uneven colour. To obtain the best results, the tobacco should become fairly moist and fairly dried out once in every twenty-four hours. The opening and closing of the shed require to be done with judgment, because it is by the process of allowing the tobacco to become alternately soft and dry that the leaf is properly cured. If the season during which the tobacco is being cured is excessively hot and dry, means must be found to keep the shed moist. In this case it is necessary to hang cloth round the inside of the shed to retain moisture; while, instead of threading the leaves on string and fastening to the laths immediately on being brought into the shed, the leaves should be partly sweated on the floor of the curing shed, spread in lots of twelve leaves one above the other, back to back, and face to face, covered with green leaves. If the floor of the shed is made of earth, it is necessary to spread bags beneath the leaves to keep them off the damp floor, otherwise the bottom leaves will get black and discoloured. Particular care must be taken not to sweat the leaves when damp with wet or moisture. Allow them to remain in this position forty-eight hours, or until the edges of the leaves turn a yellow colour; the remainder of the leaf will also be of a slightly yellow shade; when this colour is attained, thread as prescribed; put the laths on the bottom tiers for twenty-four hours, allowing the leaves on each lath to touch one another; shut the shed during the day and open at night.

Great care must be taken to prevent excessive moisture, as pole sweat, mould, or other damage to the leaf arises in that case, and must be prevented. The curing of the tobacco is completed when the mid-ribs of the leaves are completely dry, so that they will break if bent between the fingers. The time for curing the tobacco that has been primed is from twenty to twenty-two days, at which time it is ready

to be fermented, or the laths may be adjusted on the top tiers of the shed, and there remain until such time as sufficient dry tobacco is in condition to handle; all the doors and ventilators must be kept open during the night previous to putting into the press. The next morning the tobacco will be in what is called "good case," that is, it should have taken up sufficient moisture to become soft and pliable. The tobacco should contain at least 25 per cent. of moisture before being put in bulk (press); then the process of fermentation gives the leaves a light brown colour.

Fermentation of Cigar Leaf.—The fermentation, or sweat, is for the purpose of developing the aroma of the tobacco. On the ability of the leaf to properly ferment, and on the skill of the man in charge to regulate that fermentation, depends the quality of the finished product. This fermentation, as before stated, is due to the action of enzymes, and these enzymes must be subjected to certain heat and moisture conditions before they can begin their action. Tobacco should contain 23 per cent. to 24 per cent. of moisture to ensure a proper fermentation; tobacco with a higher percentage of moisture is more subject to decay, and tobacco with less moisture will not ferment, or if fermentation does commence there will not be moisture enough present for its completion. The proper condition is soon learned by experience, and no test except the feeling to the hand and the pliability of the leaf is required.

Several different methods of fermentation are practised. In the method that has been most largely used, until recently, the tobacco is packed in wooden cases, holding about three hundred pounds of tobacco to a case. The butts of the "hands" are placed to the outside and the tips to the centre of the case. By means of a screw or lever the tobacco is pressed down moderately tight, and as much air as possible excluded. The top of the box is then screwed on and the case placed in a room that is kept at an even temperature. The box has moderate sized openings between the boards, so as to allow for the escape of the moisture and other waste products of fermentation. The tobacco is left in these cases for a summer and is then sampled and repacked to await sale to the manufacturer. At times the cases may be placed in heated rooms and the fermentation forced. This method of fermen-

tation does not give altogether satisfactory results. The tobacco in the cases cannot be observed, and there is no knowledge as to whether the fermentation is proceeding properly or not. To-day the tendency among progressive tobacco men is towards the adoption of what is known as bulk fermentation.

Bulk Fermentation.—The best rooms for this purpose are heated with steam, and kept at a temperature of from 75 degs. to 80 degs., and the humidity maintained at 80 degs. to 90 degs., and even as high at times as 100 degs.

When the tobacco is received for fermentation it is sorted into three different grades, according to the colour and texture. This is done so that the different grades may be fermented separately and given different treatment according to the nature of the finished product desired. Just at present the demand is for light shades in the wrappers, and if the wrapper leaves be given as heavy a fermentation as the filler leaves their colour will become dark.

When graded the tobaccos are placed in separate bulks. The number of pounds of the lighter grades allowed to the bulk is from three to five thousand; of the medium grades from eight to ten thousand; and of the ordinary fillers from ten to thirty thousand. The greater the fermentation desired the greater the percentage of moisture that the leaf is allowed to retain when bulked. The wrappers, therefore, are in a somewhat dryer condition than the fillers. These bulks may be from four to five feet wide, from four to eight feet high, and of any length. The length and the number of pounds placed in a bulk is limited somewhat by the labour at the disposal of the fermenter, for often, when the temperature is rising rapidly, the bulk must be taken down and rebuilt in a very short time, and it takes a considerable number of persons to properly handle, say, thirty thousand pounds of cigar leaf. No pressure beyond the weight of the tobacco is applied to the bulk, for it is desired that there be some space for the movement of air and the escape of the products of fermentation. The bulk is not built directly on the floor, but is placed on a platform raised a few inches above the floor. This platform is covered with a layer of wrapping paper. The butts of the tobacco are placed toward the outside of the bulk, and the tips toward the centre. The first row is laid with the butts even with the

edge of the bulk, the second row is placed so that the butts rest on about one-third of the tip end of the first row, and so on with the third row. Three rows in from each side, or six rows in all, is all that the ordinary bulk will require. The process is repeated until the bulk has reached the desired height. Where fine wrapper leaf is being bulked, strips of wrapping paper are often placed under the butts of each row so as to prevent injury to the leaf under it. When the bulk is completed it is covered with canvas, blankets, or rubber sheeting.

The temperature will begin to rise in a short time, and will continue to increase at the rate of from five to fifteen degrees per day, depending on the percentage of moisture present, until the temperature of the pile reaches 130 degs., when the bulk must be broken down and rebuilt.

In building the new bulk, the tops and sides of the old bulk should form the centre of the new. Each "hand" should be given a shake as passed over, to free it from any of the objectional products of fermentation, and lessen liability to rot and mould. The temperature of the tobacco will be lowered in handling to about the temperature of the room. The bulk will again heat up, but not so rapidly perhaps as the first bulk. In eight to twelve days the thermometer will indicate that the pile has reached a heat of 125 degs. or 130 degs., or that perhaps it has ceased to rise in temperature and remains stationary. In either case the bulk is to be rebuilt.

This process of rebulking may have to be repeated six or eight times, or until the best aroma possible is obtained. If the process be carried too far, the desirable products obtained in the earlier fermentation may be destroyed, and the tobacco left about as valuable for smoking purposes as old rags or paper. The lighter coloured wrappers must not be heated as highly or fermented as long as they would stand, or as much as might be desirable from the standpoint of aroma, for their chief value lies in their colour, and this must be preserved.

If the tobacco be too moist in the bulk, as will be indicated by its "sogginess," or a very rapid rise in temperature, it must be rebulked more often than otherwise, and in the rebulking should be handled in a dry room, which will deprive it of a portion of its moisture.

If the tobacco be found to be so dry in the bulk that fermentation ceases or is retarded, this defect may be corrected by handling it in a warm, moist, or steam-charged room. In some districts the use of steam is objected to, on the ground that it may at times give to tobacco an objectionable odour. In these places compressed air is made to create a fine spray of water, and thus moisten the air of the room and serve the same purpose as the steam. For the fillers, if deficient in moisture, a dipping of the butts in a cask of water will be sufficient, unless they are lacking in gum, in which case it is a common practice to dip the butts in a preparation made by boiling a quantity of Havana tobacco stems, and mixing the resulting thick juice with sour wine at the rate of three to one. After being dipped in this, the tobacco is placed in cases or small piles and covered up for a day, so that the moisture may become evenly distributed. The new bulk is then made. A fine mist of steam or spray of water may be added to the tobacco, but the direct addition of water may slightly injure the colour of the leaf.

When low grade fillers cease fermentation before the desired stage is reached, they are treated with the following "petuning" solution :—Two gallons rum, one gallon sour wine, one half-pint tincture of valerian, one ounce oil of aniseed, one half-gallon black coffee, one ounce pulverised cloves, one ounce pulverised cinnamon, two pounds liquorice paste dissolved in water, and sufficient water added to make five gallons. After being allowed to stand for twenty-four hours and thoroughly mixed, the preparation is ready for use. As the bulk of the tobacco is being made, a fine spray of this is placed on each layer. The moisture added aids somewhat in the process of fermentation, but the main idea of this preparation is to add to the tobacco an artificial aroma resembling that of Cuban tobacco. This "petuning" is never done to high-grade tobacco.

When a tobacco is slow in heating, it is sometimes sprayed with a solution of ammonia carbonate. The reason for this is that the contents of the leaf give an acid reaction because of the accumulation of free acids, and the ammonia carbonate combines with these acids and gives a neutral condition favourable to the action of oxidising enzymes.

A temperature of 130 degs. is probably as high as the tobacco should ever be allowed to rise. Expert tobacco men will judge the condition of a pile by the insertion of their arm, but most persons should trust nothing but an accurate thermometer. This may be read at any time by keeping it in a perforated tin cylinder inserted into the centre of the bulk. The United States Department of Agriculture has devised an electrical thermometer which may be left in the centre of the bulk, and the readings made with no disturbance of the tobacco. The wires may be extended to a central office, and the readings of any number of bulks in different buildings be observed there.

Upon the completion of the fermentation, the tobacco is ready to be graded and packed for shipment. Tobacco is in a proper condition for baling when a "hand" that has been squeezed may have all of its leaves separated one from another by a shake. This indicates that the leaves are without enough moisture to cause them to stick one to another. The finer grades of cigar leaf are graded very closely and handled very carefully. The commoner grades of fillers are placed in three-hundred pound cases. The best grades of Cuban tobacco are made into "hands" of forty leaves each, and then four "hands" are bound together by means of Cuban bast into what is known as a "carrotte." Each carrotte weighs a pound or a little over. Great care is taken that the outside, or wrapper leaves, of the carrotte be smooth and presentable. Eighty carrottes are then made into a bale, which is pressed into shape in a press, and is covered first with canvas and then with the inside bark of a Cuban tree. Only the best grades of goods are made into carrottes. The second grade, or damaged leaf, is given a thorough second sweat and stemmed, smoothed, and flattened out, and made into what is known as a "book of fillers." In stemming, not all of the mid-rib is removed, but a piece about two inches long is allowed to remain in the tip of the leaf. These books are then made into Cuban bales.

The Sumatra tobacco is made into "hands" of about forty leaves, each leaf being folded. These hands are packed into bales, being spread out fan-shaped and carefully flattened as packed. The fillers are made into Cuban "carrottes," and the broken leaves into "books." The bales are flat, and are covered with matting, as is done in Sumatra.

From "Tobacco Leaf: Its culture, cure and manufacture."
Orange Judd Company, New York.

Each bale or package of tobacco should be carefully labelled as to grade, weight, time of packing, and the name of the seller, so that any errors may be traced out and corrected and the reputation of the packer established.

The bales of the best wrappers, where no fermentation is desired, are placed in a cool room. If further fermentation is wished, as in the case of the fillers, they are placed in a warm room. The wrapper bales should be stood on end and reversed every other day for several weeks. They may then be piled one upon another. The filler bales may be piled at once and their position reversed at least once a week. The wrappers will be in condition to manufacture in three months after baling, and the fillers in six months.

Ageing.—After a tobacco has been cured it must go through a process of ageing before it is fit for consumption. Fermented tobaccos require less ageing than the ordinary unfermented tobaccos. Smoking tobaccos are allowed to age for at least two years before being manufactured, and often the process is continued for four or five years. After five years there is likely to be a slight loss rather than any improvement in quality. Ageing may be described as partially a process of slow fermentation and partially an oxidation of the leaf contents without the agency of enzymes. Ageing certainly softens and mellows a tobacco, taking away its rawness and bitterness as well as disagreeable odours, and improving the aroma as well as the burning qualities of the leaf. No tobacco, and particularly no tobacco from a district that is trying to obtain recognition, should be marketed before it has developed the qualities that come with age.

Some of the Chemistry of Curing and Fermentation.—During the fermentation of tobacco there is a loss of as high as fifteen per cent. in weight. Part of this is due to the loss of moisture and a part to the loss of solid matter, through the decomposition of different products and the development of gases. The presence of ammonia is easily detected by the odour in the fermentation room. This is produced as a result of chemical changes in the tobacco.

The starch largely changes to sugar, and the sugar formed is largely consumed in the curing process; the remainder of both of these products is usually destroyed in the fermentation.

As soon as the sugar is largely consumed the enzymes attack the protein contents of the plant cells, and these continue to be destroyed to a certain extent throughout curing and fermentation. With the decomposition of the protein there is a formation of "amido" compounds.

During the fermentation there is a loss of nitrates, a decrease in the nicotine contents, and also in the amount of tannin. A thoroughly sweated tobacco contains but a trace of tannin, and thus the bitterness, due to its presence in half-sweated tobacco, is removed.

There is also a disappearance of a portion of the fat contents. A large amount of fat, or of protein, will create products during combustion that will be destructive of the finer aroma, and one of the benefits of fermentation is that it largely does away with those compounds.

There is also a decrease of the resin and gums in fermentation. In fact, one of the methods of determining how far the fermentation has proceeded is to feel the leaf and note the presence or absence of gum. The resins and gums seem to bear a close relation to the aroma. It is probable that they are split up into other products that are aromatic. It may also be that the products arising from the decomposition of nicotine have a large part in the production of aroma. The aroma of a cigar does not appear to be based on the presence of a large amount of nicotine in the cigar; in fact, a cigar rich in nicotine may be poor in aroma; the aroma does, however, seem to be in some way related to the amount of nicotine that was in the tobacco and that has disappeared in the process of fermentation. Nicotianine has been supposed to have something to do with the aroma; but this product, which may be formed from nicotine in the sweat, does not appear in all tobaccos, some of which are rich in aroma.

It has recently been shewn that during the process of smoking an ethereal oil is formed from certain products of the sweat, and that to this oil is due a portion of the flavour of tobacco smoke.

Citric, malic and oxalic acids are present in the cured leaf, but not in as large quantities as in the green leaf. The citric and malic acids may be partially transformed in the fermentation to acetic and butyric acids. These acids certainly have something to do with the aroma. The presence of the malic

salts is supposed to make the leaves more soft and pliable, and to give life and elasticity. This is due to the hygroscopic action of these salts. Stored under similar conditions, leaves rich in malic salts may contain three per cent. more water than leaves poor in those salts.

Cured or fermented tobacco is said to have "grain"; this grain is a product of the oxidation in the sweat, and some manufacturers consider the presence of a well-developed grain as an evidence of good tobacco. It is at least an evidence that the tobacco has been thoroughly cured. This grain is due to the formation of crystals of calcium oxalate.

During the curing and fermentation processes there often appears on the leaf an efflorescence, called by tobacco men "saltpetre," or by some "light mould." This is due to the presence of potassium, sodium, magnesia, calcium and nicotine salts. These salts may be present in the leaf in excess, and are forced to the surface in the process of curing or fermentation. Their presence greatly injures the saleability of the tobacco. A spray of a four per cent. solution of acetic acid, or a weak vinegar, will remove them, although more appear later. Sometimes these salts are taken off with a light brush. It is supposed by some that the presence of these salts is due to an excess of their basic elements in the soil, or to the fertilisers used. This may be true, for it is known that plants will take up mineral salts in excess of their requirements, if those salts be abundant in the soil.

All tobaccos will not go through an equal degree of fermentation. In some the fermentation proceeds very slowly, in others rapidly. In some tobaccos the fermentation may continue a long period, while in others it may be completed in a short time. This difference is due to the presence of oxidising enzymes in greater or less proportion. Difference in soil, climate and cultural treatment will bring about great differences in the enzymes present in the leaf, and thus naturally a difference in the fermentation of each tobacco. The methods to be pursued in the fermentation of each new tobacco will have to be worked out for the special case involved.

BUILDINGS: THE CURING BARN.—The present curing barn is the result of an evolutionary process. At first the tobacco was hung in the sun upon bushes to dry; the next step was the curing rack; after this came the hanging of the tobacco in any

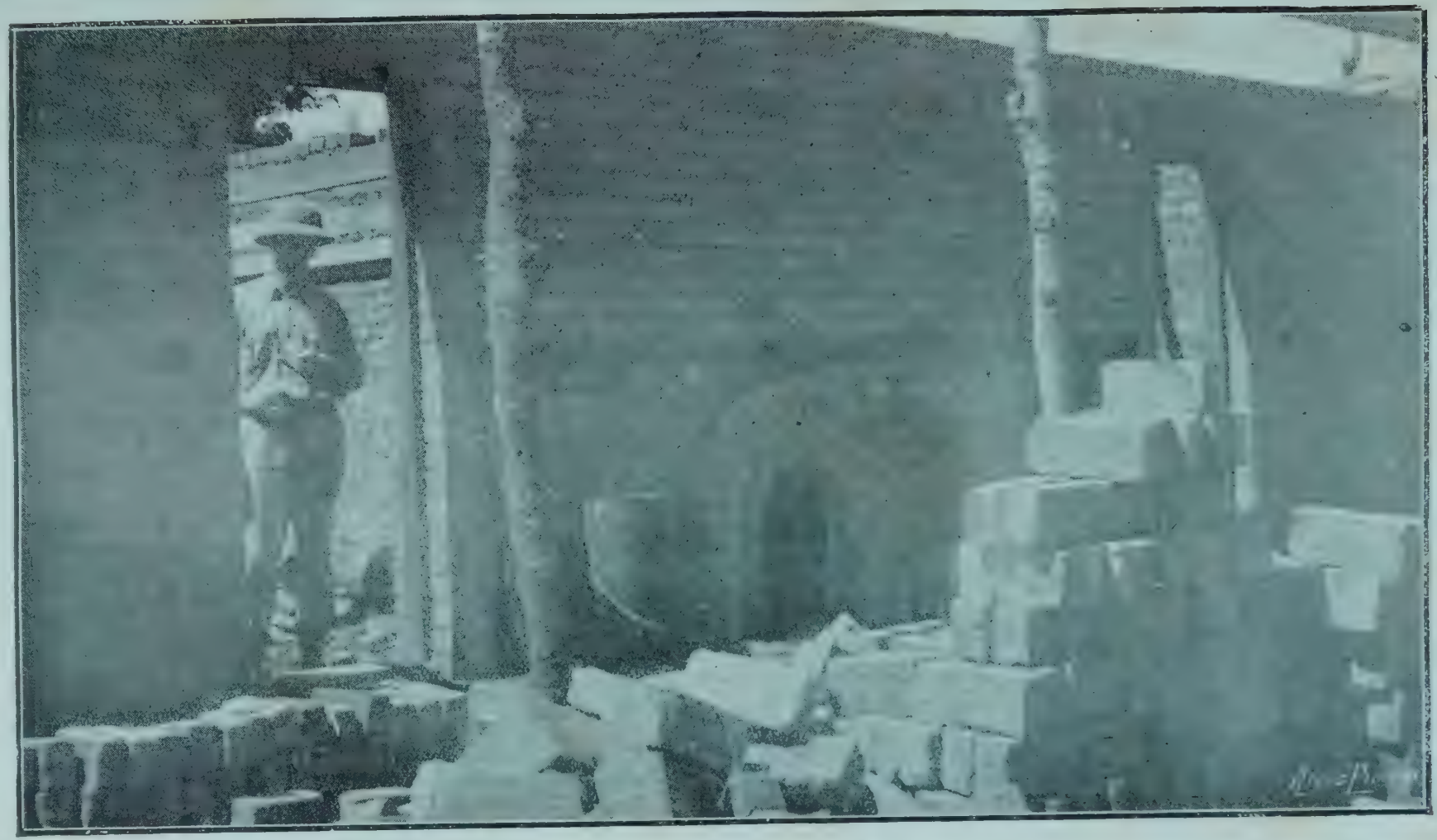
old building that could be used; then came rough log buildings and sheds for the tobacco crop alone; and finally came the construction of buildings where the conditions could be governed by ventilation. In the use of fire, there have been gradual changes from a smoky smudge to the use of charcoal, and then to the adoption of the flue system, where smokeless dry heat is used. We have no reason to think that we have reached perfection in the construction of the curing barn, or in the method of applying the heat.

The perfect curing barn is one that is so constructed that the tobacco may be handled with the least labour, and so ventilated and heated that the temperature and moisture conditions are absolutely under control. The heat should be applied in a form that is free from all odours, and the system used should be such that desired temperatures can be maintained, with the minimum of labour and no unnecessary waste of material. It should be constructed out of the material most easily and cheaply obtained in the locality, providing that material has the qualities necessary to a curing barn.

As will be remembered, the curing of yellow or gold leaf tobacco takes but four or five days, and during that time requires well regulated and, at times, intense heats. The barns are not large, being of a size that can be filled by a few people in a very short length of time, the idea being that all the tobacco in the barn should be in the same condition, and that the curing process should be started at once. The barn defined on the accompanying plan will hold from 700 to 800 lbs. of leaf, and may be estimated to be capable of curing about eight acres of tobacco in one season. The cost of erecting such a barn with a packing house is approximately £150.

Plans and Specifications for Flue Curing Tobacco Barns.—The particulars given below refer to flue curing barns constructed for the purpose of treating Virginia leaf according to the approved process for the production of bright tobacco, but modifications to suit specific cases will no doubt occur. However, the following details will serve to indicate what may be regarded as standard patterns of a barn and packing house :—

Specification.—Clear the site of all rubbish and leave level. Dig the trenches for foundations 2 feet wide and 2 feet deep, or to such further depth as may be required to obtain a



Shewing Furnaces built inside the Barn.

level and solid bottom. The sides of the trenches should be dug square. Build the foundations with the best stone procurable locally, in hammer-dressed rubble set and bedded in good dagga, all well bonded, and having no straight joints; no stones to have round faces, and no small stones to be used except where absolutely necessary for bringing surface up to true level. Foundations to be 2 feet wide by depth required by solid bottom, to finish not less than 6 inches above ground level at highest point. Flush up on completion, and well ram the earth to foundations.

On top of finished foundations lay a damp and ant proof course of 2 to 1 cement mortar 1 inch thick, laid truly level, or zinc with 6 inch lap.

In every yard of face-work there must be at least one through stone and at all corners.

Build the walls 14 inches to a height of 4 feet above the foundations and the remainder in 9 inch work with good hard well-burnt bricks, well bonded, set and bedded in 2 to 1 lime mortar or good clay dagga, all joints truly vertical and horizontal, every course well flushed up, and all outside joints to be raked out and painted in cement. No half-bricks to be used except where legitimately required for closers. All joints to be struck as the work proceeds. All crevices to be filled in.

The bricks for surface arch and the door and window arches must be rubbed down, and the latter arches must have a skew-back of not less than 4½ inches. Build in all door, window, and ventilating frames, all secured with hoop iron.

In a double barn the dividing wall must be carried up in a similar manner to gable ends. Do all beam filling.

Put a 3 to 1 cement mortar weathering to top of foundations.

Construct the roof, doors and windows as shewn on plan.

Cover the roof with 24 gauge galvanised corrugated iron sheets 11 feet long each, free from corrosion or other defects. Iron to have a vertical lap of one and a half corrugations, to be secured to purlins with galvanised iron screws and galvanised iron and lead washers. Iron to fit close at ridge and against wall of lean-to roof. Cover the ridge with 18 inch galvanised iron ridging, fixed as specified to iron, and beaten down into corrugations of iron.

Put to the eaves 4½ inches o.g. galvanised iron guttering fixed to fascias with proper bolts and tubes well soldered at joints. Put 3½ inches diameter galvanised iron downspouts where marked R.W.P. on plan supplied, with proper bands and shoes.

The dimensions given on ground plan, 16ft. by 16ft. are measured from the 9-inch work.

The first 4½in. by 1½in. runner should start at a height of 7 feet from the floor level, instead of at 6 feet, as shewn on section.

There should be eight ventilators to each barn, not as shewn on ground plans. Plan of single barn shews only six, and plan of double barn only four ventilators. It is desirable that one of the ventilators should come immediately over the furnace.

Quantities for Single Barn.

Bricks	18,400 (say 20,000).
Corrugated Iron	20/11ft. sheets.
Wall Plates	2/17 4½in. by 1½in.
Fascia	4/12, 2/18 6in. by ⅞ flooring.
Inside Quartering for Centre and Wall Uprights ...	3/20, 12/16 3in. by 2in.
Inside Runners	15/16 4½in. by 1½in., 20/16 3in. by 1½in. (intermediate rails).
Roof Timbers	5/19 (tie beams), 15/11 (rafters and struts) 4½in. by 1½in.
Roof Purlins	6/19 3in. by 2¼in.
Gable and Ground Ventilators	7/12 4½in. by 1½in. for framing.
Gable and Ground Ventilators	1/18 6in. by ⅞in. for panels.
Lintels	1/12 4½in. by 3in.
Door Frames	1/15, 1/8 3in. by 3in.
Batten Doors	4/13 6in. by ⅞in.
T Hinges	2 pairs, 18in.
Barrel Bolts	2 6in.
Screws and Washers ...	3 gross 2½in. screws.

Nails	5lbs. 2in., 15lbs. 3in., 15lbs. 4in.
Ridging	4 lengths 18in. galv. iron.
Down Pipes	7 lengths 3½in.
Guttering	6 lengths 4in. half-round.
Bolts and Nuts	105 lengths 5in. by ½in. for inside timbering.
Cement	2 casks.
Pulleys for Ventilators ...	2 single, 2 double.
Cord for Ventilators ...	100ft. ¼in.

Quantities for Double Barn and One Packing House.

Bricks	56,000 (say 60,000).
Corrugated Iron	72/11ft. sheets.
Wall Plates	20/16 4½in. by 1½in.
Fascia	4/12, 8/18 6in. by ⅞in. flooring.
Inside Quartering for Centre and Wall Uprights ...	10/20, 20/16 3in. by 2in.
Inside Runners	20/16 4½in. by 1½in.
Inside Runners	40/16 3in. by 1½in. (intermediate rails).
Roof Timbers	15/19 (tie beams), 30/11, 15/15 (rafters and struts) 4½in. by 1½in.
Roof Purlins	430ft. 3in. by 2¼in.
Gable Ventilators	7/12 4½in. by 1½in. for framing.
Gable Ventilators	1/18 6in. by ⅞in. for panels.
Lintels	3/12, 1/18 4½in. by 3in.
Door Frames	3/15, 1/16 3in. by 3in.
Batten Doors	6/13, 12/8 6in. by ⅞in.
T Hinges	5 pairs, 18in.
Barrel Bolts	8 6in.
Windows	2 8in. by 10in. 12 light American stock.
Screws and Washers ...	12 gross 2½in. screws.
Nails	10lbs. 2in., 25lbs. 3in., 25lbs. 4in.
Ridging	16 lengths 18in. galv. iron.
Down Pipes	21 lengths 3½in.
Guttering	24 lengths 4in. half-round.

Bolts and Nuts	210 5in. by ½in. for inside timbering.
Cement	8 casks.
Pulleys for Ventilators ...	2 single, 2 double.
Cord for Ventilators ...	100ft. ¼in.

Quantities for Four Barns and One Packing House.

Bricks	83,400 (say 86,000).
Corrugated Iron	72/11ft., 22/10ft., 22/9ft. sheets.
Wall Plates	28/16 4½in. by 1½in.
Fascia	4/12, 4/17, 4/18, 4/21 6in. by ⅞in. flooring.
Box Gutter	8/16 6in. by ⅞in. flooring.
Box Gutter	1/12ft. 3in. by 1½in. for bearers.
Box Gutter	4 lengths sheet zinc for apron.
Inside Quartering for Centre and Wall Uprights ...	20/20, 40/16 3in. by 2in.
Inside Runners	60/16 4½in. by 1½in., 80/16 3in. by 1½in. (intermediate rails).
Roof Timbers	30/18 (tie beams).
Roof Timbers	50/11 (struts and rafters).
Roof Timbers	15/19 (struts and rafters, on small principles).
Roof Timbers	2/14 (valley rafters). All timbers 4½in. by 1½in.
Roof Purlins	610ft. 3in. by 2¼in.
Ventilators in Gables ...	7/12 4½in. by 1½in. for framing.
Ventilators in Gables ...	1/18 6in. by ⅞in. flooring for panels.
Lintels	6/12, 1/18 4½in. by 3in.
Door Frames	5/15, 3/9 3in. by 3in.
Batten Doors	24/13, 12/8 6 by ⅞in. flooring.
T Hinges	9 pairs, 18in.
Barrel Bolts	12 6in.
Windows	2 8in. by 10in. 12 light American stock.
Screws and Washers ...	18 gross 2½in. screws.

Nails	14lbs. 2in., 40lbs. 3in., 40lbs. 4in.
Ridging	24 lengths 18in. galv. iron.
Down Pipes	35 lengths 3½in.
Guttering	36 lengths 4in. half-round.
Bolts and Nuts	420 5in. by ½in. for inside timbering.
Cement	12 casks.
Pulleys for Ventilators ...	2 single and 2 double for gable, and 4 double for roof ventilators.
Roof Iron for Vents. in Roof	2/10ft. sheets galv. iron.
Framing for Vents. in Roof	4/16 4½in. by 1½in.

We recommend that the inside measurements of a furnace built inside the barn should be:—Length, 5 feet; width, 2 feet; height, 2½ feet.

Other Barns: A Florida Barn.—This barn is constructed for the curing of cigar leaf, but may be used for the curing of any tobacco with the exception of the yellow. It is ninety-six feet long by thirty-six feet wide; is sixteen feet from the sills to the plate, and thirteen feet from the plate to the ridge pole of the roof. The tier poles are four feet apart each way, so that there are four tiers with the plate tier and below, and two tiers above the plate. Where the priming or single leaf system is used, the tiers are but two feet apart vertically. Where the barn has four-foot tiers, it may be changed to suit occasions by the stretching of heavy wire, so as to alternate with the original tiers. The barn has several double doors in the side, and has a series of windows or openings along both sides, that close with shutters hung from the top with hinges. These are for the purpose of ventilation. Along both sides at the base and the top there is another series of ventilators. They are long and narrow, and are closed with doors composed of one board, hinged at the upper side.

This barn is constructed entirely of timber, and rests on brick pillars. For its construction there is required twenty-one thousand feet of timber, and thirty thousand shingles, also two thousand bricks, two barrels of lime, seven kegs of nails, and a quantity of hinges, staples and wire. The total cost in Florida when erected and before it is painted is about £120.

Several modifications of this barn are in use. In one, the doors are at the end of the building, and the central tier poles arranged so that they may be removed, and the wagon driven into the barn. As the barn fills up, the tier poles are replaced and filled. The ventilators on both sides are vertical, and are long and narrow, being but eighteen inches wide, and the height of the side of the barn. They are hinged at the top and opened at the bottom. The vertical ventilators have one fault, and that is, when open they will allow the entrance of a drifting rain. Where the nature of the construction will allow it, horizontal ventilators should be constructed. They should be but a foot wide, and may be as long as the board out of which they are made. They should extend in rows along both sides of the barn, and these rows placed one above another in every three or four feet of the side of the barn. It is also necessary to have several ventilators in the gable ends of the building, to provide for the ventilation of the peak of the barn. The ventilators should be hinged from the top, and so constructed that they may be held open at any point of elevation. They should also be adjusted so that they may be opened or closed by means of levers worked from the ground. One ninety-six foot barn will hold all the tobacco from two or even three acres of cigar leaf, or twice that acreage of other tobaccos. Where the cutting season extends over a period of two months or more, the same barn can be used for two different curings.

A Pennsylvania Barn.—This barn is a very elaborate one. It is forty-one feet wide and eighty-four feet long; twenty-nine feet from the wooden floor to the plate, and about eighteen feet from the plate to the ridge pole. The room holds seven tiers of tobacco in the body and three tiers in the peak. The building is ventilated by horizontal openings four feet apart, and so arranged as to be on a level with each tier of tobacco. These ventilators are a foot wide and are arranged in vertical series of twelve feet in width, so that each series may be controlled with one lever. Half-way up the roof there is a sheltered slatted ventilator, and at the ridge there are a number of ventilated cupolas.

Under the entire barn is a basement or cellar, which is nine feet clear in height. This basement is divided into two rooms, the larger one of which is used for dampening and conditioning the tobacco, which is lowered into it through trap-

Loading Tobacco for Warehouse, Salisbury.—Darwendale.

doors in the floor. In this room the tobacco is also bulked. The smaller room is used for the stripping and grading of the tobacco. It has tables arranged all round it near the windows, and on these the stripping is done. The room is heated by a stove in cold weather, and has two doors, one of which opens into the larger room and the other to the outside of the building. The building is constructed of the very best material, is covered with three coats of paint, and fitted with all the little conveniences possible. The cost is about £800. This barn could be easily used for other purposes if the tobacco industry should at any time fail.

Packing Houses.—Every grower of bright tobacco should, in addition to his barns, have a room for the packing of tobacco. There are three essential features in a good packing house. It should be well lighted; it should be so tight that the moisture conditions can be regulated regardless of weather conditions, and it should be supplied with steam from a near-by boiler. If it is near the curing barns the same boiler that is used for the conditioning of the leaf in the curing barn can be utilised.

A boiler capable of developing 5.6h.p., and suitable for the purpose, can be purchased in Salisbury for £76 10s., or, if a larger one is desired, the following prices apply:—6.6h.p., £96 10s.; 9.0h.p., £107 10s.; 13.5h.p., £138 10s.; 22.5h.p., £196 10s.

Some growers, however, use a petrol drum for generating the steam required, but we are not disposed to recommend this as altogether satisfactory.

Steam Chest.—The conditioning of leaf for packing is done in a small chest. This chest should be four feet nine inches long, and from 2½ to 3 feet wide at the top. Steam is admitted at the bottom of the chest through a perforated pipe. Just above the pipe there should be a layer of closely-fitting curing sticks sufficient to spread the steam, and at the same time prevent the tobacco leaves from coming in contact with the pipe. Near each end of the chest a cross piece is put in, and the curing sticks with the hands of tobacco are hung on these. The lid is closed and the steam-cock opened for a few seconds. The tobacco is then sufficiently pliable to admit of

handling and packing while hot, although it will appear perfectly dry as soon as cool. The accompanying illustration of a steam chest in use at the Tobacco Warehouse, Salisbury, will give an idea of what is generally used. The cost of a steam chest in Rhodesia is £4 10s.

Baling.—The baling of tobacco in Rhodesia leaves much to be desired. Very often the leaf arrives at the Warehouse mouldy, owing to too much moisture being applied, or a lot of it goes to scrap, through the tobacco being baled in a brittle condition. As the ends of the bales are frequently left open, a good deal of the scrap even is lost *en route*. With Virginia tobacco it is necessary to securely sew the bales top and bottom with sail twine, neither the ends nor the sides being left open. The lacing often employed is not sufficient. The Warehouse desires to standardise the bales, and requests that the uniform dimensions when pressed should be: length, 34 inches; depth, 20 inches; breadth, 20 inches; weight, 125lbs.

It is hoped growers will endeavour to bear this in mind, as uniformity in this respect will considerably assist the matter of handling the leaf at the Warehouse.

It is difficult to state the actual amount of moisture that should be applied to the tobacco when baling, or to indicate what the appearance of the leaf should be, but it may be taken as a guide that when leaf is steamed sufficiently to handle while hot, and yet still appear dry when cold, sufficient moisture has been applied. If the leaf is pliable when cold it is evidence of too much moisture, resulting from over-prolonged steaming in the chest. When moistened with water the bales must be in the Warehouse within a few days.

The following system is advocated in baling Virginia tobacco:—Lay the leaf in quantities of two handsful at a time at each end of the bale, with the butts to the outside of the bulk. The tips of the leaves will nearly meet in the centre of the bale, and, in order to get an even surface, lay a corresponding quantity of leaves in opposite directions, with the butts resting on about one-third of the underneath tip end. Continue this procedure until the bulk is completed, but, in order to get a uniform compact edge, place a number of leaves *across* the bale with the butts to the outside.

Steam Chest.—Warehouse, Salisbury.

Baling Press and Steam Chest.—Warehouse, Salisbury.

The baling press needs little description. It is a simple contrivance with an adjustable box into which the tobacco for baling is placed. A vertical screw fixed to a cross-piece is used for pressing the leaf, although this has now gone out of favour with Rhodesian growers, who prefer to use an ordinary wagon jack, which is much easier to manipulate.

The baling press shewn in the accompanying illustration, although larger than the one generally in use at tobacco farms, will give an idea of what is required. The cost of a baling press in Rhodesia is £5 15s.

CHAPTER IV.

Turkish Tobacco.

Prospects in Rhodesia.—Culture.—Curing.—Baling.

Prospects in Rhodesia.—Up to the present comparatively only a small quantity of Turkish tobacco has been grown in Rhodesia, but the successful results obtained with this type by certain growers have encouraged a number of planters of the Virginia type also to grow a small crop of Turkish, and the area devoted to this variety is gradually increasing. There is not the demand in South Africa for Turkish that there is for Virginia tobacco, but there is a ready market for a limited quantity of good class leaf for which high prices are paid.

Many parts of Rhodesia are eminently suited to growing Turkish tobacco, and some of the leaf grown in the Territory has been very highly commented upon by experts in different countries: on the other hand, a certain quantity of the tobacco produced has been somewhat deficient in aroma. This might be remedied by growing the tobacco on slightly heavier soils than have hitherto been tried, and in this connection the remarks of Mr. Stewart Richardson, appearing in the June, 1912, number of the *Rhodesia Agricultural Journal*, are worthy of consideration. Experience in Rhodesia in regard to the culture of Turkish tobacco is as yet very limited, and the remarks contained in this chapter are only intended for a guide as to the general lines upon which the grower should proceed.

The Turkish seed which has been found to be most adaptable to local conditions is Cavalla, Xanthe and Baffara, which are supplied at a moderate charge by the Tobacco Warehouse, Salisbury.

Culture.—Seed beds are set out in the same way as with Virginia tobacco, but in planting out the rows are made 18 inches apart only, while the plants are set 8 to 10 inches from

Farm Buildings and Tobacco Lands, Inyoka Concession.

Turkish Tobacco at Inyoka Tobacco Company's Concession.

each other. Constant cultivation is absolutely necessary, and, as the rows are close together, it is advisable that the work should be done by hand.

Plants should be set out from the middle of January to the middle of February, the seed being sown about six to eight weeks prior to this time.

When the plant is about 18 inches high the bottom leaves should be removed, and as they are the worst leaves and not ripe, they should be thrown away. Hitherto in Rhodesia Turkish tobacco has not been topped, but where it is grown on light soils it will be found efficacious to pinch off the *blossoms* : this will produce a leaf with more body in it. With tobacco grown on heavier soils this will not be found necessary.

When the leaf ripens a distinct change can be noticed in the colour, which then becomes a light yellowish green. The leaf also loses some of its crispness. If ripe, the leaf when plucked comes away clean at the butt, without any vascular fibres from the main stem adhering.

Harvesting is begun when the bottom leaves, or number one's, as they are classed, are ripe. The numbers which refer to the position of the leaf on the plant are from one to five, the last being the small top leaves, which are the most valuable. Number two's are the largest leaves on the plant, and grow above the number one's. Number three's are the broad leaves above the two's and have more body and natural gum. Numbers four and five grow in order, decreasing in size and becoming thicker in body, and with more natural gum. Each reaping must be kept separate throughout the curing and baling processes.

Each boy reaps a single row of plants, the leaf being plucked between finger and thumb of the right hand by a sideways motion. Each leaf is placed neatly above the previously plucked leaf, the pile of leaves being carried away in a basket. It will be found that neatness in keeping the leaves in pile as reaped will save much time when the leaves are threaded. The early morning is the best time to reap, the leaves then being crisp and easily broken from the stem. Reaping is never attempted after rain until the plants are thoroughly dry. Not more than four leaves at one time should be reaped from the plant, it being better to err on the side of reaping over-ripe

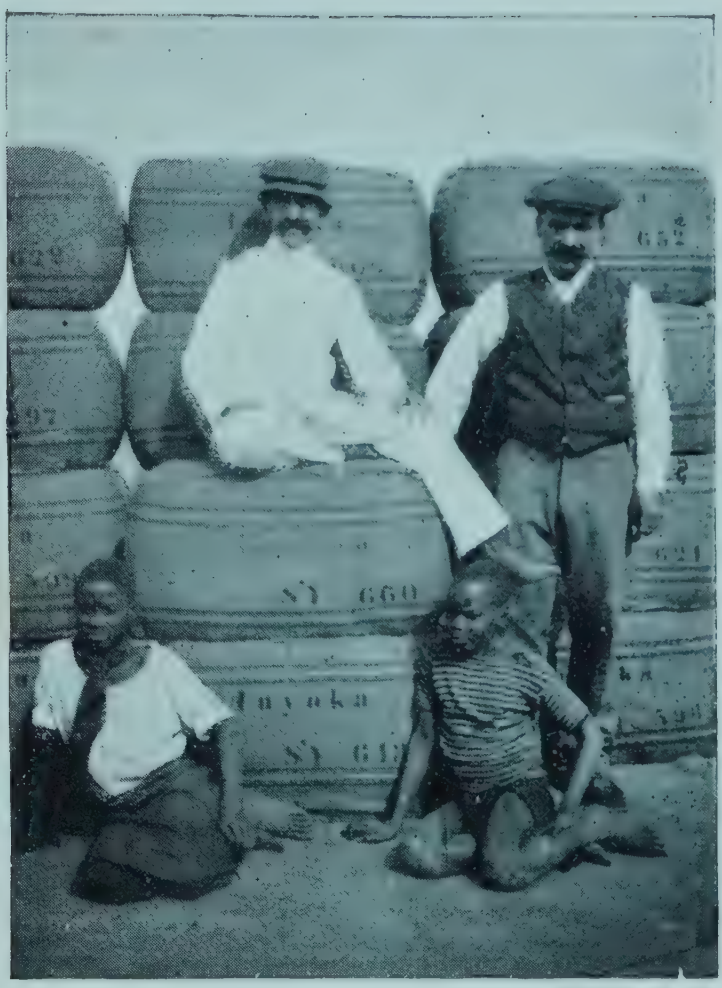
than when the leaf is green, as the greenness will be difficult to eradicate. At the same time the leaf must not be too ripe, or it will lose its quality very quickly.

When as much leaf as can be sewn in a day is reaped, the baskets are taken to the sewing shed. At this stage the leaves should be graded according to size. This is easily done and saves much subsequent labour. The needles for threading the leaf are about 16 inches long and about $\frac{1}{4}$-inch wide, flat and smooth, with sharp points and blunt edges, and provided with eyes to thread the twine through.

The assorted leaves are threaded one by one on to the needles at a point about $\frac{1}{2}$-inch from the butts, care being taken to keep the butts level. All leaves must face the same way and be packed closely together. The leaves are slipped on to the twine, and a stick about 4 feet long is laid along the string of threaded leaves; the ends are attached to the stick, and two or more bands are tied round the stick and threaded string to prevent the latter from sagging with the weight of the tobacco. All injured leaves should be sewn on separate sticks. The leaves should not be placed on the ground, as the gum causes sand to adhere to them and decreases the value of the tobacco.

Curing.—Sun-curing or air-curing has been found more suitable than flue-curing with Turkish tobacco in this country. The threaded sticks are taken to a dark shed, free from draughts, and suspended close together on racks formed of two rails 5 feet apart, or on wire stretched tight. The sticks must be examined daily, and should there be much moisture, they must be spaced apart, or they will blacken and rot. As soon as it is seen that the majority of the leaves have changed to a yellowish green colour they are removed to the drying racks.

Drying racks are made by stretching wires about 2 feet 6 inches to 3 feet from the ground on uprights spaced 4 feet apart. The wires should be 5 feet apart, which allows for 6 inches projection of the tobacco sticks on either side. Four lines of wire are usually placed side by side, the middle space being 1 foot 6 inches, where the upright poles are placed, which carry the skeleton shed of light rods to support the sails for protecting the tobacco from the weather. The length of these racks is made to suit the size of the covering sails.



Bales of Turkish Tobacco ready for export to England.
Inyoka Tobacco Company.

Turkish Tobacco ready for despatch. Inyoka Concession.

Some growers at first place the sticks close together, but not touching, and later gradually increase the distance apart, the object of varying the spaces being to regulate the drying of the leaf, so that the yellow colour may be retained. Others place the sticks about 4 inches apart, and keep the sails down for the first day. The leaves are allowed to hang on the racks until the mid-ribs are dry, a period varying with weather conditions. The sticks are now taken off the racks and laid flat on clean grass-covered ground. At night they are covered with grass or buck-sails to keep off the dew. On the following morning the sticks are turned, the reverse side of the tobacco being exposed to the sun. This process is continued for a day or two until the green shade is no longer seen in the tobacco. Should the tobacco remain green it may be finely sprayed with water in the evening, the object being to brown the leaf. The other side is sprayed next evening.

BALING.—In order to get the leaf sufficiently limp for baling, some growers make covered-in pits, in which the tobacco is hung for 12 to 24 hours. The cellars are usually made about 8 or 10 feet broad and about 8 feet deep, racks being fixed upon which to hang the sticks.

The tobacco is now removed to the storehouse. There are several methods of storing the leaf, viz. :—

(1) The sticks are removed and the strings knotted at the ends to prevent the tobacco slipping off. Five or six strings are then tied together at one end and are suspended from nails driven into rafters or rails across the shed.

(2) The sticks are placed flat on a boarded floor, one stick being laid on the tobacco of the next, thus binding the bulk, which is stacked as high as can be done with convenience.

(3) The sticks are removed and the ends of the strings having been knotted, the tobacco is stacked in bulks.

The latter is probably the best method, as retaining the sticks in the bulks tends to breakage, while tobacco hung up does not mature and improve in so great a degree as when put into bulks.

When bulking tobacco great care must be taken that there is not too much moisture in the leaf, or the bulks will start heating and spoil. Should the least sign of heating be noticed the bulk must be at once pulled apart, aired and re-bulked.

When the leaf is in a condition to be handled the strings are straightened out neatly, each leaf being put in its place, and the strings are cut to the length of the baling box, the ends being knotted to prevent leaves slipping off. As the tobacco is already graded as regards number and size, it only remains to grade as to colour, the boys putting strings of similar colour together until there is sufficient to make a bale.

The strings of tobacco are placed in the baling press with the butts outwards and tips to the centre, two layers of tobacco being placed on the outside to one on the inside strings. The number of strings in one layer varies with the size of the leaf. Neatness in baling is soon learnt after a little practice. The average weight of a bale is 80 lbs., but this varies greatly with the number and condition of the leaf.

When the bale is pressed it is removed and stitched up in canvas round top, bottom and one end, the canvas being laced together with strong string. The advantage of this is that the bales can be examined at any time. This should be done frequently after baling to ascertain if the leaf is in good condition. Should there be signs of too much moisture or any heat, the bale is set up on end, all the lacing strings having been loosened and the tobacco strings are separated, so that air may reach the interior of the bale, the bales being turned daily. When the leaf has sufficiently dried the bale is again laced.

Transporting Turkish Tobacco to Railway.
Inyoka Tobacco Company.

European Staff at Inyoka Tobacco Company's Concession.

CHAPTER V.

The Tobacco Warehouse.—The Utilisation of Waste Tobacco.

THE TOBACCO WAREHOUSE.—About the middle of April, leaf begins to arrive at the Warehouse, Salisbury, for re-ordering and grading, preparatory to the auction sale, and from that time onward for some six months or so, the building is a veritable hive of industry. The present Warehouse was erected by the Tobacco Company of Rhodesia and South Africa, Ltd., in 1911, on the most up-to-date lines, and, spacious though the building is, it has been found quite inadequate to store the increasing crop, additional buildings having to be leased for the purpose. During the 1912 season, 130 natives were employed at the Warehouse under the supervision of Mr. Rice, Manager, and his two assistants.

The illustrations reproduced give a very fair idea of the various processes the tobacco passes through at the Warehouse. The leaf is first of all steamed, in order to render it soft and pliable for handling purposes, and this is done by passing it through the chests, which will be seen in the illustration, situated at intervals through the centre of the room. The steaming chest is similar to that used by growers, the steam being admitted at the bottom of the chest through a perforated pipe. The tobacco is now graded, the work being performed by natives, who shew a fair amount of intelligence, but who require constant supervision. There are many grades, the leaf being graded not only according to colour, which, of course, varies considerably, but also in respect of quality and size. The leaves being graded, they are taken to another batch of natives, whose work it is to tie the tobacco into "hands," which consist of from eight to twenty or more leaves, according to size. The "hands" of tobacco are then trucked to the drying room, which is heated by means of hot air. The tobacco remains here for ten hours or so, after which it is again steamed and softened for baling purposes.

The tobacco is now ready for the auction sale, which usually takes place about the beginning of the year, and attracts many of the townspeople and others, in addition to those directly interested in the industry.

The Utilisation of Waste Tobacco.—Suggestions have repeatedly been made that the refuse from our tobacco fields, barns and factories might profitably be utilised in the preparation of nicotine for use as an insecticide or dip.

Waste tobacco is made up of tobacco dust, leaf unfit for smoking, and mid ribs. In America and Europe the waste leaf, etc., chiefly used in the preparation of tobacco extract is a coarse low quality Virginia or Kentucky leaf, containing about 4 per cent. nicotine—the active principle—and the standard extract contains 8 to 9 per cent. of this constituent.

Since the cost of producing extract for insecticidal purposes increases considerably as the nicotine content of the raw material diminishes, it has not been found profitable to use waste of low nicotine content; consequently it is necessary that a comparison be made between the nicotine content of locally-grown tobacco and that usually employed abroad.

Lundie, in a paper read before the Bulawayo meeting of the South African Association for the Advancement of Science, quoted the following figures as being the average nicotine content of a number of samples of Rhodesian-grown tobacco :—

Virginia leaf (Hester) flue cured ...	2.14 per cent. nicotine.
Turkish leaf	2.52 per cent. nicotine.

McCrae, in 1905, stated that the average percentage amount of nicotine in Transvaal tobacco was about 2 per cent.

For the preparation of tobacco extract these figures are so low that the prospect of competing with the imported article is not encouraging.

Whilst it is doubtless possible to produce a coarse tobacco of high nicotine content in Rhodesia, the bulk of the tobacco waste in this country at the present time is obtained from cigarette leaf and lighter qualities of pipe leaf, and not from very coarse material; the natural inference is, therefore, that the percentage amount of nicotine in the waste is low.

Tobacco Warehouse, Salisbury.

Tying Tobacco into "hands."—Warehouse, Salisbury.

Grading the Leaf at the Warehouse, Salisbury.

Taking Lundie's figures for Rhodesian leaf, and assuming that 1 gallon of water added to tobacco yields 1 gallon of extract (*i.e.*, no change in volume), to produce 1 gallon of extract containing 8 per cent. nicotine (weight of extract per gallon 13½ lbs.) will require :—

$$\frac{13\frac{1}{2} \times 8}{100} \times \frac{100}{2.14} = 50 \text{ lbs. Rhodesian Virginia leaf; and}$$

$$\frac{13\frac{1}{2} \times 8}{100} \times \frac{100}{2.52} = 42 \text{ lbs. Rhodesian Turkish leaf.}$$

The present price of reliable tobacco extract in Salisbury is 12/6 per gallon. *Making no allowance for cost of manufacture and marketing*, the value of local leaf for the manufacture of extract would therefore be :—

$$\frac{12/6}{50} = 3\text{d. per lb. for Rhodesian Virginia leaf; and}$$

$$\frac{12/6}{42} = 3\tfrac{1}{2}\text{d. per lb. for Rhodesian Turkish leaf.}$$

Scrap at the auction sales in Salisbury (January, 1912) realised 3d. to 3½d. per lb., so that at the present time the commercial prospect of using waste tobacco for the preparation of tobacco extract is not promising.

It is possible that the waste could be used for the preparation of home-made sheep dip, using one and a half or twice the amount of tobacco recommended in the usual formulæ.

As tobacco is a gross feeder and the stems are particularly rich in nitrogen and potash in readily available forms, it is good practice to return them to the soil rather than use them for the preparation of tobacco extract.

Farmers are therefore confidently recommended to return the waste and old stalks to the land as a manure rather than to embark on the questionable enterprise of manufacturing nicotine extract.

CHAPTER VI.

The Chemistry of the Tobacco Plant and its Relation to the Fertilisers used.—Green Manures.—Ashes.—Artificial Manures.—Tobacco in Rotations.

THE CHEMISTRY OF THE TOBACCO PLANT AND ITS RELATION TO THE FERTILISERS USED.—Tobacco is fertilised for the production of quantity and for the development of quality. Fertilisation of the soil for the production of quantity is a simple matter, and no more difficult than the fertilisation of the land for large crops of wheat, hay or maize. But the quality of the tobacco produced, lying deep in the shadow of nature's secrets, and being of vastly more importance than the quantity, is a far more difficult thing to control. Tobacco that does not meet with approval for human consumption is, unfortunately, of little value for other purposes. The quality of the potato can be largely decided by a determination of its starch content; the quality of maize may be estimated by chemical tests to determine its starch, protein, and fat percentage; but the quality of tobacco cannot be determined by a chemical analysis, but only by the senses of man. Colour, texture, size, aroma, flavour and combustibility are the points by which the quality of tobacco is estimated.

The different salts and compounds in the leaf, both organic and inorganic, are known to have a great effect on all of these different qualities, but the action of each one of them is as yet not completely understood. Some facts regarding the action of the different elements have, however, been obtained, and until these are understood by the tobacco planter, he will not be able to exercise his best judgment in the matter of the fertilisation of the soil. The organic compounds seem to bear the closest relation to the aroma of the tobacco, while on the inorganic salts depends largely its combustibility. It has been determined by experiments in Europe, America and Japan—

1. That chlorides (salts of hydrochloric acid) are injurious to the burning qualities of the leaf and that sulphates (salts of sulphuric acid) are also injurious in the same way.

2. That the presence of a large amount of potash in the tobacco greatly improves the burn, but that the combustibility is not proportional to the percentage of potash present, but is dependent on the amount of potash in excess of the amount required to combine with the mineral acids such as hydrochloric and sulphuric acids, and that the fire-holding capacity of the tobacco is, to a great extent, dependent upon the contents of potash combined with organic acids.

3. That large amounts of magnesia tend to injure the capacity for holding fire.

4. That lime, whilst not greatly affecting the fire-holding capacity, is an essential factor in the production of a good ash.

5. That the small percentage of iron and aluminium oxides that may be present in the leaf have no apparent effect on the combustibility.

The tobacco plant requires certain quantities of several different elements, as calcium, potassium, iron, sulphur, phosphorus, nitrogen, etc., to complete its development, but it will be seen that the presence of an excess of some substance, *e.g.*, sulphates or chloride, is harmful to the commercial product, and that the presence of others, potash, for instance, in excess of the real needs of the plant is beneficial to the cured article. Therefore, the conclusion must be that in the use of fertilisers for the stocking of the soil with those ingredients of plant food it usually lacks (as potash, phosphoric acid, and nitrogen), materials should not be used that have as impurities elements likely to be injurious, such as chlorine, which is ordinarily present in the form of common salt (sodium chloride).

A large percentage of nitrogen in the soil increases the production of albuminoids, and a large percentage of albuminoids in the leaf is considered objectionable, for they cause the leaf to burn badly, and to have a disagreeable odour. An excess of nitrogen also tends to the production of a thick, coarse leaf, and such a leaf will burn less readily than a leaf of finer texture. The heavier and coarser the leaf the greater is the tendency to the formation of nicotine. The accumulation of nicotine and

of an excess of albuminoids is more injurious to the quality of ordinary smoking tobaccos than it is to cigar leaf, for those compounds are largely reduced and transformed during the process of fermentation that the latter leaf goes through.

Phosphoric acid is usually deficient in tobacco soils, and must be supplied, but an excess of phosphoric acid in the leaf has a tendency to hasten the ripening process, and may injure the burning qualities of the leaf.

No fixed formulæ can be given for the fertilisation of tobacco, for the reason that the elements, and the amounts required, will differ with each change of soil and climate. The grower himself must determine, from his knowledge of the soil and its requirements; of the tobacco plant and its nature; and of the action of different fertilisers and their relative cost, as to the extent and composition of the manuring that he will give his land.

Farm yard manure is one of the best fertilisers where a large, coarse leaf if desired, but where the finer types are to be produced, it must be used in lesser quantities and be supplemented with commercial fertilisers. Manure, if used in excess, will make the leaf produced thick and strong. However, stable manure has a value beyond that of its apparent fertilising value. By its decay in the soil it warms it and stimulates plant growth. The decaying of the manure also assists in the dissolution of different fertilising elements, and in placing them in a condition to be of value to the plant. It also encourages the action of the beneficial nitrifying bacteria, and improves both the drainage and the water-holding capacity of the soil by the addition of humus. Humus is decayed animal or vegetable matter. The greater the amount of humus in the soil, the greater the tendency to the thickening of the texture and the darkening of the colour of the leaf, so that there is a point in the production of fine tobacco where the addition of further humus is not desirable. Swamp or vlei lands are, as a rule, rich in humus, and the humus may, or may not, be rich in nitrogen, that being a matter dependent upon the nature of the vegetation that formed the humus, and upon the drainage conditions that the humus has been subjected to. To sum up the situation, kraal manure, while not recommended for bright tobacco soils, may be used with good results for the production of heavier types of pipe and chewing tobaccos.

Tobacco at Sleamish Farm, Mazoe. Note stunted plants where fertiliser was not used.

GREEN MANURES.—Humus and nitrogen may be added to the soil by the ploughing under of green manure crops of the leguminose order, such, for instance, as beans, peas, cow-peas, ground nuts, beggar weed, Egyptian clover, etc. The soil may also be enriched in nitrogen by growing upon it such leguminose crops as naturally form nodules in their roots. Among the more luxurious nodule bearing crops are ground nuts and cow-peas (or kaffir beans).

A leguminose crop which it is intended to plough under should be sown thickly and as early in the season as possible, since the fodder should be turned under, if possible, not later than the end of February. This early ploughing-in before the rains have ceased ensures the thorough decay of the haulms before the following ploughing season. When it is only desired to enrich the soil in nitrogen and humus is not urgently needed or if the succeeding crop will not be tobacco, kaffir beans, cow-peas, or ground nuts may be sown. The crop of seed may be reaped and the vines returned to the soil and ploughed under. The decay of the nodules on the roots of these plants will supply nitrogen, while the yield of seed will return a profit, and so defray the cost of labour. On the other hand, the dry vines will not decay so rapidly as if they had been ploughed in when more succulent, and in most cases the land will not be in good condition for early planted tobacco the following season. For late planting, a non-leguminose but quick maturing crop, such as buckwheat, may be used, and this can generally be ploughed under in less than two months from the date of sowing.

Nitrogen may be added to the soil in other forms, as nitrate of soda, sulphate of ammonia, or nitrate of potash. This latter salt has the additional advantage of supplying the potash as well as the nitrogen for the crop.

Potash may be added to the land in the form of ashes from wood fires. These ashes will have their value largely impaired if exposed to rains and allowed to leach before being placed on the field.

ASHES.—Ashes which have been exposed to the air for some time, protected from rain, are more suitable for light tobacco land than wood ashes in a fresh state. In fresh wood ashes the bulk of the lime, which is one of its principal con-

stituents, is present as quicklime or slaked lime. By exposure, the lime changes to carbonate, and carbonate of lime is not so powerful as quicklime or slaked lime in promoting the decomposition of organic (vegetable) matter, the excessive loss of which is very detrimental in the case of light soils. Applied in adequate dressings, wood ashes *in a fresh state* are more suited for use on heavy soils rich in vegetable matter.

Artificial Manures.—The potash fertilisers employed usually come from the mines of Germany. They consist of a number of different salts, several of which, as "kainite," contain large amounts of chlorine in the form of common salt and magnesium chloride, which would be injurious to the quality of the tobacco. High grade sulphate, sold under a guarantee to contain no chlorine at all, is one of the best forms to be used for the tobacco crop.

The carbonate would appear to be the best form in which to apply potash for combining with the organic acids in the plant; but, apart from the high cost of the material, there is a serious objection to its use, for it has a very strong alkaline reaction and it seems probable that it would eventually seriously injure the productiveness of the soil if used in large quantities. It will neutralise the evil effects of the injurious elements already in the soil, and its presence will be greatly beneficial to the burning qualities of the tobacco.

Ground bone and ground phosphate rock are two of the forms in which phosphoric acid may be applied. When these have been treated with sulphuric acid they are known as dissolved bone and superphosphate. The use of the acid makes the phosphate more soluble and more available for the plant.

Lime is an essential to the growth of the plant, but most soils contain sufficient for the actual needs of the tobacco plant. Lime's chief value to the crop lies in a secondary action. Where the soil is acid it corrects the acidity, and promotes nitrification by encouraging the action of the nitrifying bacteria. In the heavy close clay soils it promotes floculation, or the combination of the small particles of the clay into larger bodies, thus making the soil more friable, easy of cultivation, more rapidly drained, aerated, and better adapted to the production of roots and the development of plant life. It has

Shewing the Root System of a Tobacco Plant.

also the power of making certain food materials in the soil, that are insoluble and non-available, of use to the plant by displacing them from their present combinations. This is particularly true of lime's action on potash, and not unfrequently lime is given the credit of being of great value to the plant in the matter of plant food when its action has really been simply to make other materials available.

A crop of a thousand pounds of leaf, if the stalks be returned to the field, may be said to remove from the soil about forty pounds of nitrogen, five pounds of phosphoric acid, and fifty pounds of potash. This does not mean, however, that only this amount of these elements must be available, or be added to the soil each year, to produce a good tobacco crop. The tobacco plant in Rhodesia makes its growth in about ninety days, and fertilisers to be available to the growing crop must be in an easily soluble form. Where the fertilisers are added in forms that are not easily soluble larger amounts must be used. The tobacco roots do not reach and secure all the materials present in the soil and available; therefore allowance must be made in the fertilisation for this, and also for the fact that some of the more soluble forms will be washed out by the rains and lost. The soil already contains amounts of the elements needed, and, if it be well balanced, it may not be necessary to fertilise heavily for several years. However, if the process of depletion without restoration be continued, the soil will become exhausted and of little value. It is a much easier process to maintain the fertility of the soil than it is to restore it.

Of the fertiliser formulæ which have so far been given a trial on bright tobacco soils in Rhodesia, the following has given the best results :—

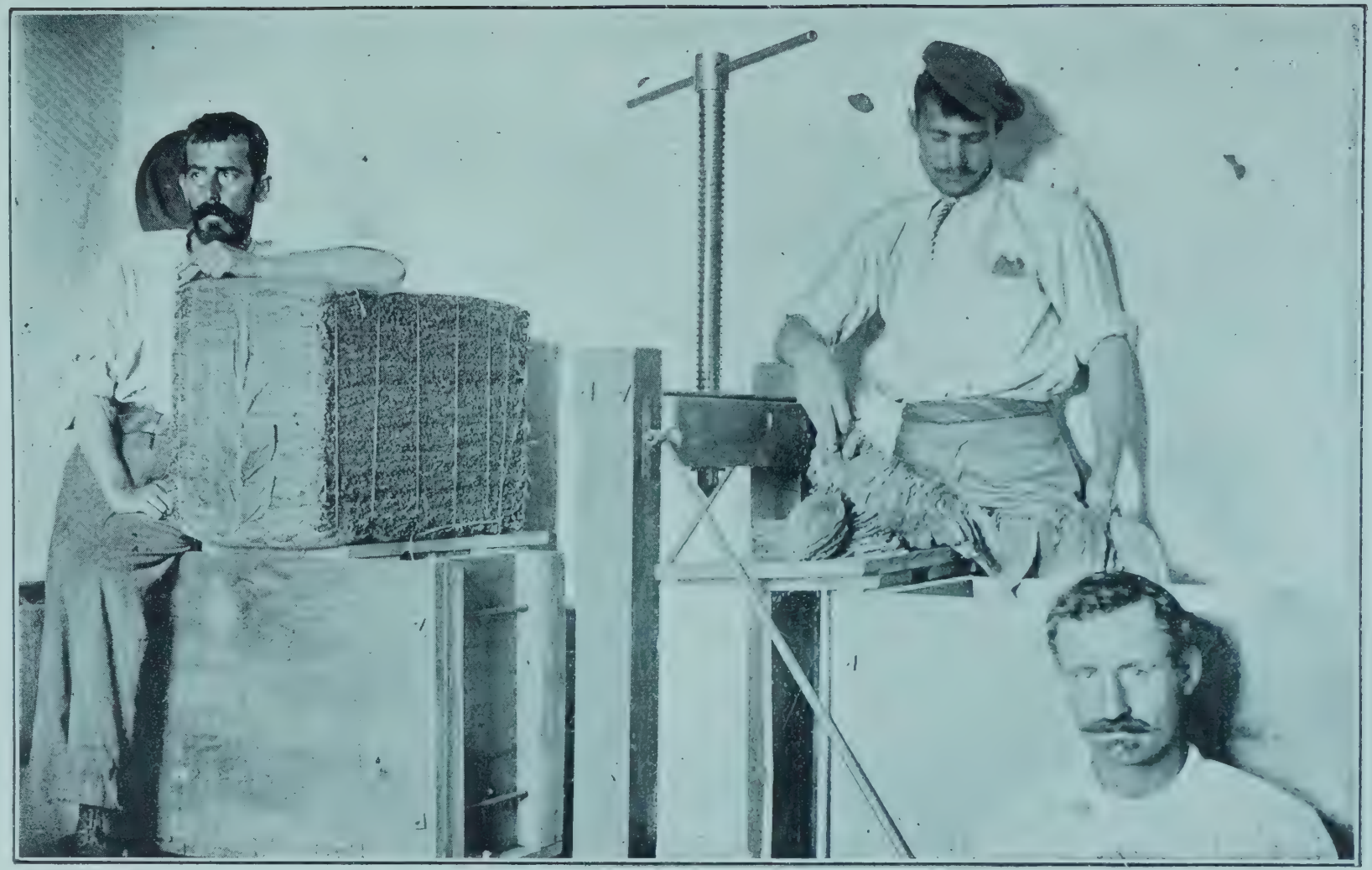
Nitrogen	8 per cent.
Phosphoric Oxide soluble in water ...	20 per cent.
Phosphoric Oxide insoluble in water	4 per cent.
Potash	10 per cent.

the nitrogen being present in the fertiliser in the readily soluble nitric and ammoniacal forms. A fertiliser conforming to this formula is obtainable on the local market at £22 10s. per ton, less 5 per cent. for cash. The general dressing applied to light sandy soils varies from 200 lbs. to 300 lbs. per acre.

Several methods of applying fertilisers to the soil for the tobacco crop are in use. In the few cases where broadcasting over the land and drilling in the row immediately before setting out the plants have been tried, the results have been very satisfactory, and, should future trials prove equally so, these methods will assuredly come into general use, on account of the saving of labour when compared with the systems most commonly adopted at the present time, viz., placing the fertiliser on the surface around each plant, or in the holes prepared when the plants are set out.

With level cultivation the practice in Rhodesia is to place the fertiliser round the plants as soon as they shew signs of growth. The fertiliser is placed around each plant in a shallow circle about 6 inches in diameter, but a saving of labour would be effected if the fertiliser were dropped at the side of each plant, just in front of the cultivator, which, when worked close to the plants as we advocate, would throw the fertiliser to the plant. The quantity of " Safco " applied to each plant should be a tablespoonful, which works out at about 200 lbs. to the acre. When the tobacco is planted on ridges, the fertiliser can either be applied by hand around each plant in the manner already mentioned, or it can be drilled in. A mealie planter with a fertiliser attachment is generally used in this country for this purpose, and for the present gives satisfaction.

The value of a fertiliser must not be estimated by the number of tons applied, but by the percentage of actual fertilising materials in each ton. Fertilisers containing large percentages of fertilising elements command a much higher price than fertilisers containing lower percentages, but the higher priced fertilisers are in reality much less expensive to buy than the lower priced ones. There is much less number of pounds of freight to be paid for in comparison with the actual fertilising material received, and much less labour required in their application. Then again, where the percentage of fertilising elements is low, something must be used as a filling and to give weight, and the material used may be injurious to the quality of the crop. Rags, woollen waste, animal matter and certain animal manures tend to the production of disagreeable odours and flavours in the tobacco when they are used as fertilisers.



Baling Turkish Tobacco. Barker Bros., Bulawayo.

In the production of tobacco, there may be localities where it will pay better to give attention to the production of quantity rather than quality, and in such places large quantities of stable manure and nitrogenous manures may be used and no attention given to impurities.

Nitrogenous salts should not be applied in any great excess of the present needs of the plant, for they will largely wash out of the soil before the next growing season and be lost. Potash is not so available, and perhaps should be applied in excess of the apparent requirements of the plant, but not in any great excess, for, while it is not so likely to leach out of the soil as is nitrogen, it will form insoluble compounds, and be unavailable for the following crops. Where it has become insoluble, it may be released by the use of lime. Phosphate fertilisers when in only partially soluble forms, as the ground bone and phosphate rock, should be applied greatly in excess of the present needs of the plant, for they will become slowly soluble during a period of years, and be available to several crops. Where the dissolved bone or mineral superphosphate is used, a large excess must be avoided. Lime is better if added in moderate quantities each year, than if all placed on at one time, for lime leaches easily and is carried down to lower levels by the drainage water. Lime also gets in a form where it is of less use as a neutraliser of acids and a dissolver of potash combinations.

Tobacco in Rotations.—A rotation of crop is of primary importance in all arable farming operations, and no less so in tobacco growing. Not only will the rotation crops improve the physical condition of the soil, but, as has been shewn, they can be selected for their soil-enriching properties. Further, experience in Rhodesia has repeatedly demonstrated the inadvisability of growing tobacco on the same land for more than two years in succession. Each year the tobacco crop has been manured with artificial fertilisers, and there remain in the soil, therefore, large supplies of plant food which must be utilised to the best advantage. Some of the more profitable crops which can be grown in rotation immediately after tobacco are potatoes, haricot or Canadian wonder beans, sweet potatoes, summer oats and summer wheat. Maize is probably best grown immediately after kraal manure has been applied or after a leguminose crop has been ploughed under. Working on these

lines, a five course rotation more or less as follows may be evolved. The first two seasons tobacco manured with artificials; the third season, potatoes, haricot beans, wheat, oats, or Egyptian clover; the fourth year, ground nuts, kafir beans, cowpeas, or buck wheat, which may either be partly harvested and then ploughed under, or treated solely as a green manure crop, and ploughed under before fully mature. In the fifth season, the land, if necessary, might be dressed with kraal manure and sown to maize. It is not as yet possible to lay down the most profitable form of rotation, but the above-mentioned crops are all suitable for the purpose, and by somewhat following the rotation suggested, the most profitable use of the residual value of the fertilisers may be made.

From "Tobacco Leaf: Its culture, cure and manufacture."
Orange Judd Company, New York.

CHAPTER VII.

Insect Pests of Tobacco in Southern Rhodesia.

Cutworms.—Stem Borer.—The Tobacco Miner or Splitworm.—Wireworms.—Root Gallworm.—Caterpillars.—The Budworm.—Beetles.—Large Cricket.—Grasshoppers.—The Cigarette Beetle.—Triboleum Confusum.—Tobacco as an Insecticide.—Mosaic Disease.—" Frog Eye," or Leaf Spot.—Tobacco Mildew.—House Burn.—Moulds and Rots in Cured Tobacco.—" Saltpetre."—Damage by Wind.—Hailstorms.

Tobacco in Southern Rhodesia is not as yet attacked by insect pests to an extent equal to what appears to be the case in some other countries. Comparing our condition with parts of the tobacco growing area of the United States of America, we may congratulate ourselves that we have no "hornworm," no " true budworm," and no " flea beetle " to contend with. At the same time, there are several pests in this country which do not occur in the United States, whilst certain pests common to the two countries are at least as destructive in this territory as across the water. It is really astonishing to observe the number of insects that will eat tobacco, and it is owing purely to the tremendous vitality of the plant that the aggregate damage is not greater. The most troublesome pests, from their general prevalence, are the cutworms, especially in the seed-beds. The stem borer (*Phthorimaea heliopa*) and the so-called " wireworms " sometimes cause serious and unexpected losses in the field. The root gallworm (*Heterodera radicicola*) is a serious tobacco pest occurring in the territory, but as yet only once reported as affecting tobacco. To avoid the introduction of this trouble into tobacco lands calls for watchfulness on the part of the growers.

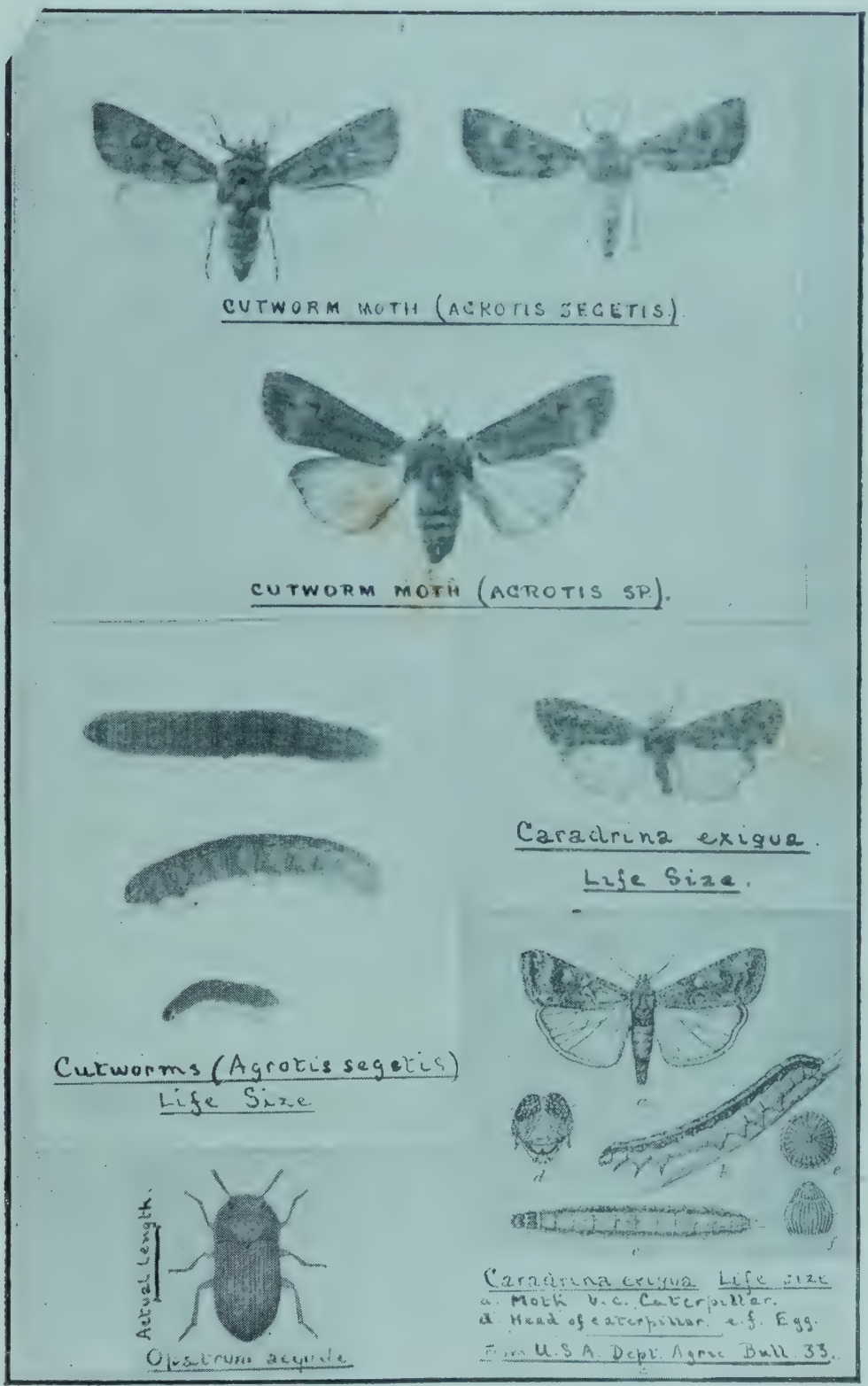
The writer owes it to himself to state that the following notes on the pests of tobacco in Southern Rhodesia are very

incomplete, as comparatively little time has been available for the study of these insects up to the present, whilst the number of new forms not recorded as pests in other countries renders the task of investigation a labour of some years.

Cutworms.—This name originated in the United States of America, the term "worm" being erroneously applied to caterpillars generally, and the full name referring to the insect's habit of severing the stems of plants close to the ground. In England these insects are called "surface caterpillars," and this name is more legitimate than the other, but crisp and euphonious terms have a way of establishing themselves, and it would be useless to attempt to dislodge the name "cutworm" from general use in this country. The Cape Dutch call these insects "mest-wurmen," but the name is also applied to the whitish grub of certain beetles, many of these grubs feeding in manure. The name "mest-wurmen," as applied to the insects under discussion, is, of course, absolutely incorrect, because, in the first place, they are not worms, and, secondly, they do not in the usual way feed on manure. As they are, however, likely to abound wherever a rank and succulent vegetation exists, they are common enough on the borders of manure heaps.

Cutworms are the caterpillars of a number of different species of night-flying moths of inconspicuous brown or grey colouration. In Southern Rhodesia there are several species more or less injurious. Six species have already been separated out at the Agricultural Laboratories, and no doubt there are more that will come to light in time. One of the commonest species, *Agrotis segetis*, known in England as the "turnip moth," is figured on the plate. Another, *A. ypsilon*, the "greasy cutworm," is also figured, and appears to be especially fond of tobacco seed beds.

In general, the habits of cutworms are simple. The gravid female moth selects a situation amongst suitable vegetation, and deposits her eggs on the stems of plants or on some convenient object near by. The eggs hatch in a few days. In India the eggs of the "greasy cutworm" are reported to hatch in as little as one and a half days, but the time taken by most species is usually considerably longer. The young larvæ enter the soil, where they mostly lie concealed during the day, feed-



Insect Pests of Tobacco in Southern Rhodesia.

ing at night. The time taken by a larva to attain full growth varies with the season of the year and the quantity of food available. A number of larvæ of one species, bred from egg to pupa in the laboratory with abundant food and moisture, began to change to pupæ on the thirty-eighth day, and had practically all changed by the fortieth day. On the other hand, cutworms are quite capable of fasting altogether for several weeks, and taking up the thread of their development again after this period, so that the duration of the larval stage is very variable indeed.

The pupa or chrysalis stage is passed in the earth. Most species construct cells of earth bound together by some gummy substance which hardens on drying. These cells doubtless serve to shield the pupa from sudden changes in temperature and from contact with water. The duration of the pupal stage is very variable. In India, where the "greasy cutworm" has been studied in some detail, the pupal period is given at from ten days to a month. In this country, one species has varied from about twelve days to about six weeks, whilst another took twenty days. *A. segetis* has been found to vary from a fortnight to thirty-eight days in the pupal stage. The pupal stage in general is longer in winter than in summer.

The female moth lays a large number of eggs. In the case of *A. segetis*, as many as 1,700 have been counted from a single female.

Preventive Measures.—Preventive measures must aim at two things: (1) to see that the seedbeds are free from cutworms when the seed is sown, and (2) to prevent them from becoming infested after the plants are above ground. To ensure the former, the beds should first of all be thoroughly burnt over with wood or dry tobacco stalks. This is usually done in Southern Rhodesia, but burning the beds alone is not sufficient owing to the presence of cutworms in the surrounding ground. To get rid of these, the use of poisoned bait is recommended. This is an old and well-known method of destroying cutworms, and several different formulæ are used. A formula recommended in the United States of America consists of:—

Molasses	2 quarts.
Paris green	1 lb.
Wheat bran	50 lbs.

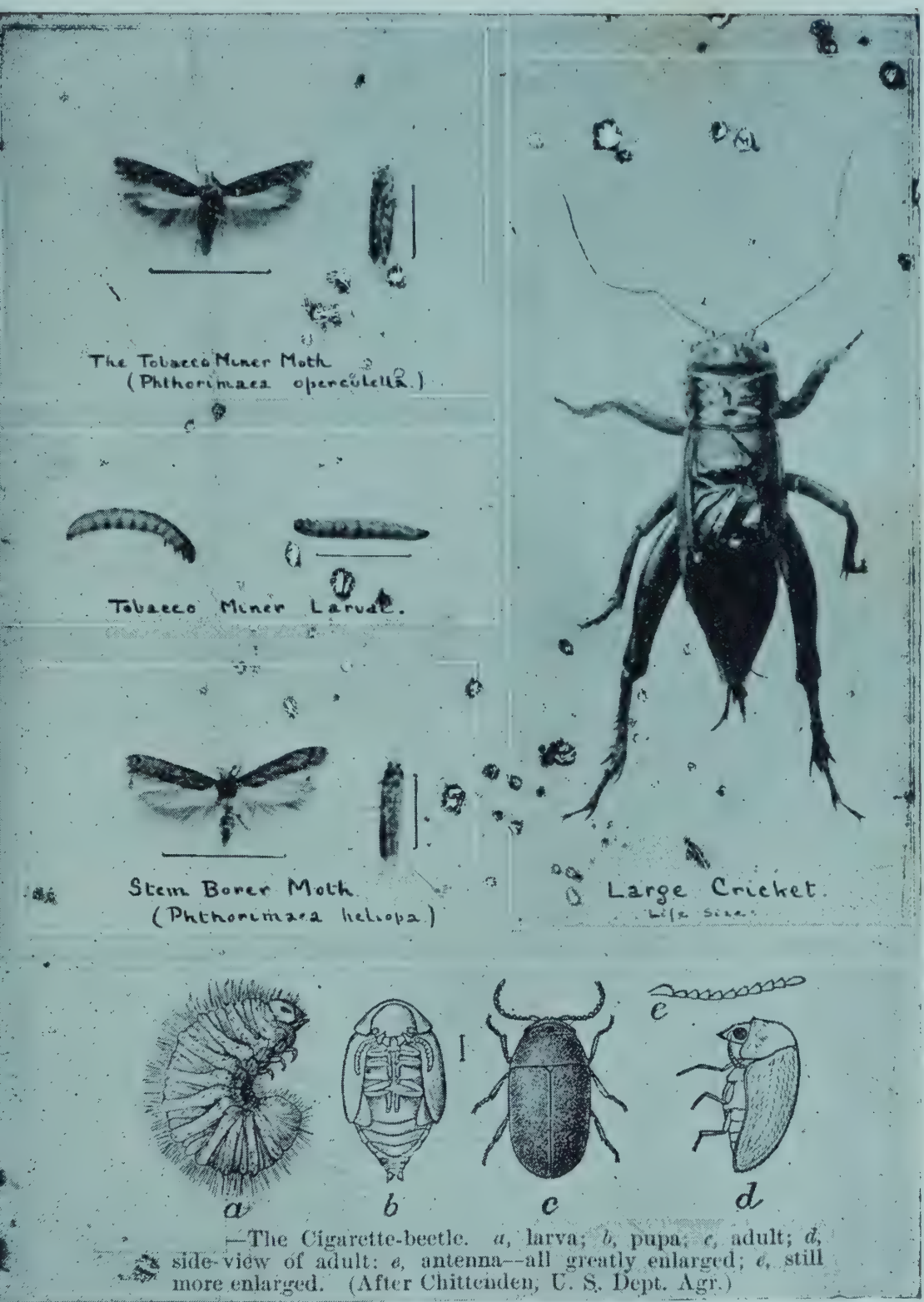
The bran should be made into a mash, of the consistency of porridge, with the molasses and sufficient water. The Paris green should then be thoroughly stirred into the mash. Maize may be substituted for bran and arsenate of lead for Paris green.

The Mally formula recommended in the Cape Colony is as follows :—

Arsenite of soda	1 lb.
Treacle or black sugar	8 lbs.
Water	10 gallons.

The arsenite should be dissolved in about a pint of boiling water and added to the treacle or sugar solution. Arsenite of soda is a cheaper and more rapidly effective poison than Paris green. This solution can either be used to make up a mash with bran or meal, or, if any greenstuff is available, it can be chopped up finely, wetted with the poison, and distributed broadcast but very thinly over the ground. The poisoned bran or meal is usually distributed in spoonfuls about the ground, and it remains moist and attractive longer if placed under a piece of board or anything that will keep the sun off. It is possible that maize meal is not quite such a good medium as bran to carry the poison, but the meal is present on every farm, whilst the bran, which is also a rather more expensive material in this territory, would have to be purchased specially. Cutworms will eat sweetened meal quite readily when fresh, and in cage experiments have shewn little preference for either bran or meal. The chief drawback to meal is that it dries up into a very hard and solid mass. The use of chopped greenstuff, of course, lessens the expense considerably, but unfortunately greenstuff is very scarce on most farms in September, when the seed beds are being prepared. If irrigation is being practised, or an early crop is being grown on naturally moist ground, greenstuff will be the cheapest material to use. There is, of course, no difficulty in growing a quantity of lettuce or other hardy vegetable to furnish greenstuff for baiting purposes.

It must be borne in mind that tobacco seed beds in the months of October and November constitute an attractive array of succulent vegetation, when succulent vegetation is scarce elsewhere, and that cutworms are likely to be attracted thither from some distance round. It is advisable, therefore, to clear



—The Cigarette-beetle. *a*, larva; *b*, pupa; *c*, adult; *d*, side-view of adult; *e*, antenna—all greatly enlarged; *f*, still more enlarged. (After Chittenden, U. S. Dept. Agr.)

Insect Pests of Tobacco in Southern Rhodesia.

the ground for some distance round the beds, say 30 yards in all directions, and to bait this ground thoroughly before sowing. If the beds are in a rich vlei, as they usually are, the surrounding veld is liable to contain cutworms in September and October. The clearance will leave a wide margin over which the cutworms would have to travel to reach the seed beds.

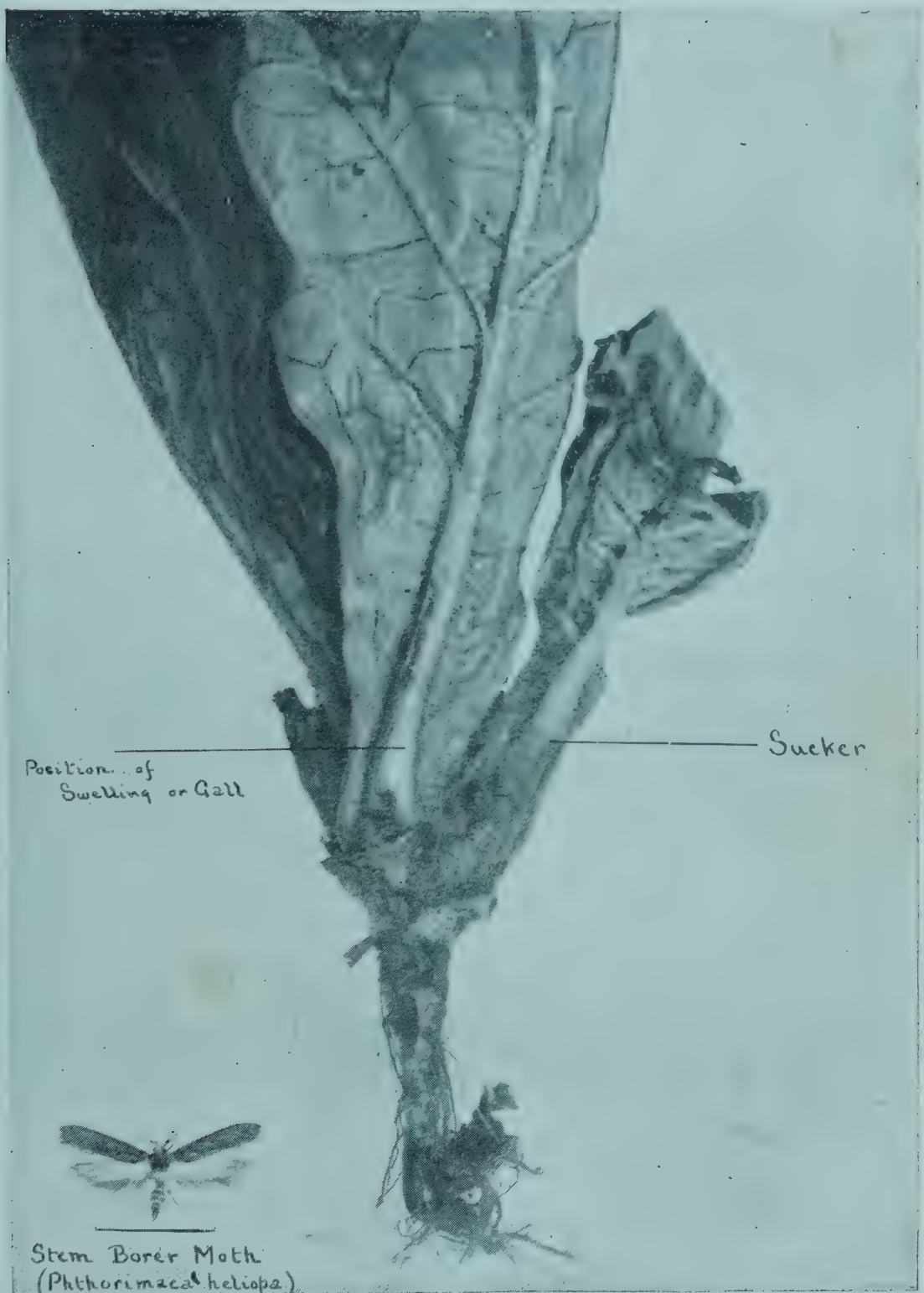
Whatever form of bait is used, it should be distributed towards evening to avoid the drying effect of the sun's heat. The bait is most effective the first night after distribution, and if the ground treated has been cleared for some little time, the cutworms will be hungry, and the great bulk should find the bait and poison themselves during the first night. The baiting can be repeated with advantage a week later.

To protect the beds from becoming infested with cutworms after the plants are above ground, the greatest care should be given to the soundness of the covering material, to its proper adjustment each night, and to the tightness of the bricks enclosing the beds. The aim is to exclude the adult moths, which are liable to be attracted by the array of green, to deposit their eggs on or about the plants. The plants are above ground in the seed beds for nearly seven weeks, whilst cutworm eggs hatch in from a week to ten days, and it has been found in the course of feeding experiments at Salisbury that the larvæ of one species attain the length of three-quarters of an inch in about seventeen days. They are then entering upon a very destructive period in their lives, and are capable of severing plants of some size. In twenty-eight days their length had reached one inch, and from this time forward for about eight days, when the insects began to pupate, their appetite was very voracious and their growth very rapid. It will be seen, therefore, that eggs laid on young plants produce cutworms that increase in size with the plants, and are big enough to sever the plants when nearing a condition of suitability for planting out. When it is remembered that a single female moth may lay upwards of seventeen hundred eggs, the desirability of excluding them from the seed beds is obvious. Cutworm moths are nocturnal in habit, so that the coverings of the beds need only be moth proof at night. A tour of inspection round the seed beds the last thing in the evening would repay the trouble. This method can hardly be relied upon to exclude all moths, as some are likely to find their way in through any opening that is left.

The great preventive measure in other countries is given as *clean cultivation*, especially as applied to keeping down the weeds during the time the crop is off the land. In this territory, however, the dryness of the winter usually ensures the absence of succulent vegetation from most tobacco lands between the months of May and November, except it be volunteer tobacco plants growing out from the ploughed-in stalks. These should always be destroyed, on account of several pests. As a matter of fact, cutworms are rarely very troublesome in the lands. Sometimes, however, naturally moist soil is used to secure an early planting, and if such a course is intended, care should be taken to keep the ground free from weeds during the winter, or the loss from cutworms may be considerable. The planter should always bear in mind that cutworm moths are on the wing in September, looking for succulent plants amongst which to deposit their eggs, and that if cutworms hatch and enter the ground, subsequent ploughing will destroy the available food, but not the cutworms themselves to any great extent, and that the tobacco plants, when placed in the ground, come as a welcome supply of nourishment to the hungry insects.

The land may, of course, be baited for cutworms, as already described, before planting out, or a spoonful of the bran or meal may be placed by each plant as a safeguard.

Remedies.—When cutworms are abundant in a tobacco seed bed full of plants, they are not by any means as easily destroyed as they are before the plants come up. There is an immense supply of succulent food everywhere, and, though the bait be distributed through the bed, its attractiveness does not extend probably beyond a few inches—hence the value of preventive measures. To get the best effect, it will probably be best to make up a bran or meal bait of arsenate of lead or Paris green, so as not to injure the plants, and distribute it abundantly through the beds, so that as many cutworms as possible will come into the sphere of its attractiveness. Arsenite of soda, being a soluble form of arsenic, is injurious to vegetation with which it comes into contact. This is about all that can be done if the cutworms are very small and attacking the young seedlings. Larger cutworms can easily be found by digging in the surface of the soil near the newly-severed plant. Natives usually have something in the nature of a special aptitude for this kind of work, and a few good "boys" are



Insect Pests of Tobacco in Southern Rhodesia.
Stem Borer Moth and Bored Plant.

capable of ridding a considerable quantity of seed bed of cutworms in a short space of time, and of rendering the use of insecticides unnecessary. Each half-grown cutworm destroyed may be reckoned as a score or more of plants saved.

In the field, cutworms may be destroyed by hand as above, but here the plants are very much wider apart than in the seed beds, and the distribution of poisoned bait after the damage has commenced is of considerable value, and should be practised if necessary.

STEM BORER. (*Phthorimæa heliopa. Lcr.*)—This little insect is, without doubt, a native of South Africa, but it is also recorded as injurious to this crop in India. The moth is closely related to the tobacco miner, and is similar in size. It is, however, readily distinguished by its redder coloration. The larvæ of the two species are very much more difficult to identify. They are whitish caterpillars, often delicately tinted with pale green and pink. They reach a length of half an inch. The life history has not yet been followed in this country. Mr. Maxwell Lefroy gives the following short account of the life history in India :—" The moth lays a single egg on the leaf stalk, the emerging larva boring down through the leaf stalk to the stem in which it lives. Pupation takes place inside the stem, the full-grown larva preparing an exit hole through which the moth can escape." He adds, elsewhere :—" Apparently the pest is not injurious to healthy vigorous tobacco, but is worst in a season of drought." Experience in Southern Rhodesia points to the fact that serious damage usually occurs as the result of infestation of the seed beds. The moth is evidently on the wing very early in the season, for the seedlings are frequently attacked when quite small. The presence of the larva in the stem causes a swelling to form, and above this swelling the plant will not grow. Suckers grow out from beneath the swollen portion on the stem, but if unaided, practically no leaf worth reaping is produced.

Preventive measures lie in keeping the moths from the seedlings in the beds, by careful attention to the soundness and adjustment of the covers, especially at night, and in discarding seedlings shewing swellings when planting out. All volunteer tobacco plants growing on the lands about the seed beds and about the homestead should be destroyed during the winter, as they provide breeding places for the moth.

Remedial measures are not practicable in the general way, but it is said that if the plant is severed below the swelling, and all but the strongest suckers removed, a fair amount of leaf will be produced, provided the plant is young enough.

The Tobacco Miner or Splitworm (*Phthorimæa operculella*).—This insect is closely related to the preceding, and it is a very difficult matter to distinguish between the larvæ of the two insects. The tobacco miner, however, chiefly attacks the leaves, and, although also found in the stems, is not known to produce any swellings. The insect is also a bad pest of potatoes, not only mining the leaves and stems of the plants, but boring the tubers. It thus possesses an alias in the form of the "potato tuber moth."

The female moth lays her eggs singly on the plant. The eggs hatch in from six to ten days, and the young larvæ eat into the tissues. They eat out the substance of the leaves in irregular patches, leaving only the upper and lower skins. These patches are semi-transparent when the leaf is held up to the light, and the larvæ may commonly be seen inside the leaf. They have a habit of leaving old mines and starting new ones, and this habit is of some importance in connection with control measures. When full-fed the larva changes to a pupa inside the plant, the moth under favourable conditions emerging in about five weeks from the hatching of the egg. The time, however, depends upon the temperature.

As tobacco is not at present grown for the purpose of making cigar wrappers in Southern Rhodesia, the injury to the leaves is not of the same importance as it is in some other tobacco-growing countries. The lower leaves of the plant are chiefly attacked, and where priming is carried out, many of the infested leaves are removed. Much good leaf is, however, liable to attack, and it is no uncommon sight in the barn to see hundreds of these caterpillars hanging by threads from the drying leaves, or crawling rapidly over the ground in endeavours to escape the uncomfortable heat.

Preventive measures lie in covering the seed beds thoroughly at night, and in destroying the plants which might serve as breeding places for the moth during the winter. This insect also breeds in the common weed known as the thornapple or "stinkblaar" (*Datura stramonium*), and this should be destroyed as much as possible about tobacco lands.

Insect Pests of Tobacco in Southern Rhodesia.
Tobacco Miner Moth and Mined Leaf.

Spraying the plants with arsenate of lead or Paris green would be likely to destroy many of the insects when starting new mines. In some parts of the United States it is the practice to send labourers through the fields to crush the larvæ inside the leaf tissue, but this is probably only done where the leaves are used as cigar wrappers.

"WIREWORMS."—The insects which go under this name in Southern Rhodesia are not true wireworms as the word is usually applied. The destructive wireworms of Europe and America are the grubs of "click" beetles or "skipjacks," belonging to the family *Elaterida*. The grubs injurious to tobacco in this territory are the young of a family of soberly coloured beetles of the family *Tenebrionidæ*, which includes the "tok-tokje" beetles amongst others. These grubs have not yet been bred out to the adult stage, but there are probably several species involved. The grubs are of a slightly flattened sub-cylindrical form, light yellowish brown in colour, and may reach a length of two and three-quarter inches. They are armed with a formidable pair of jaws, with which they are able to sever tobacco stems of some thickness, thus destroying the plant. They are usually brought to light when the wilted plant is noticed and dug up. They attack the plants as soon as the field is planted, but are also reported to kill healthy plants in full growth.

The probability is that the eggs are laid in the natural veld, and that the insects attack tobacco because it happens to be the plant within their reach, and not because they have any natural preference for it, but that they thrive upon the diet is shewn by the fact that land is often found to be infested the second year as well as the first. Probably the insect takes more than one year to mature.

In rare cases the injury to tobacco by this pest may be severe, the crop being rendered altogether unprofitable. Usually, however, the insect is present in but small numbers, and the percentage of plants destroyed is quite inconsiderable.

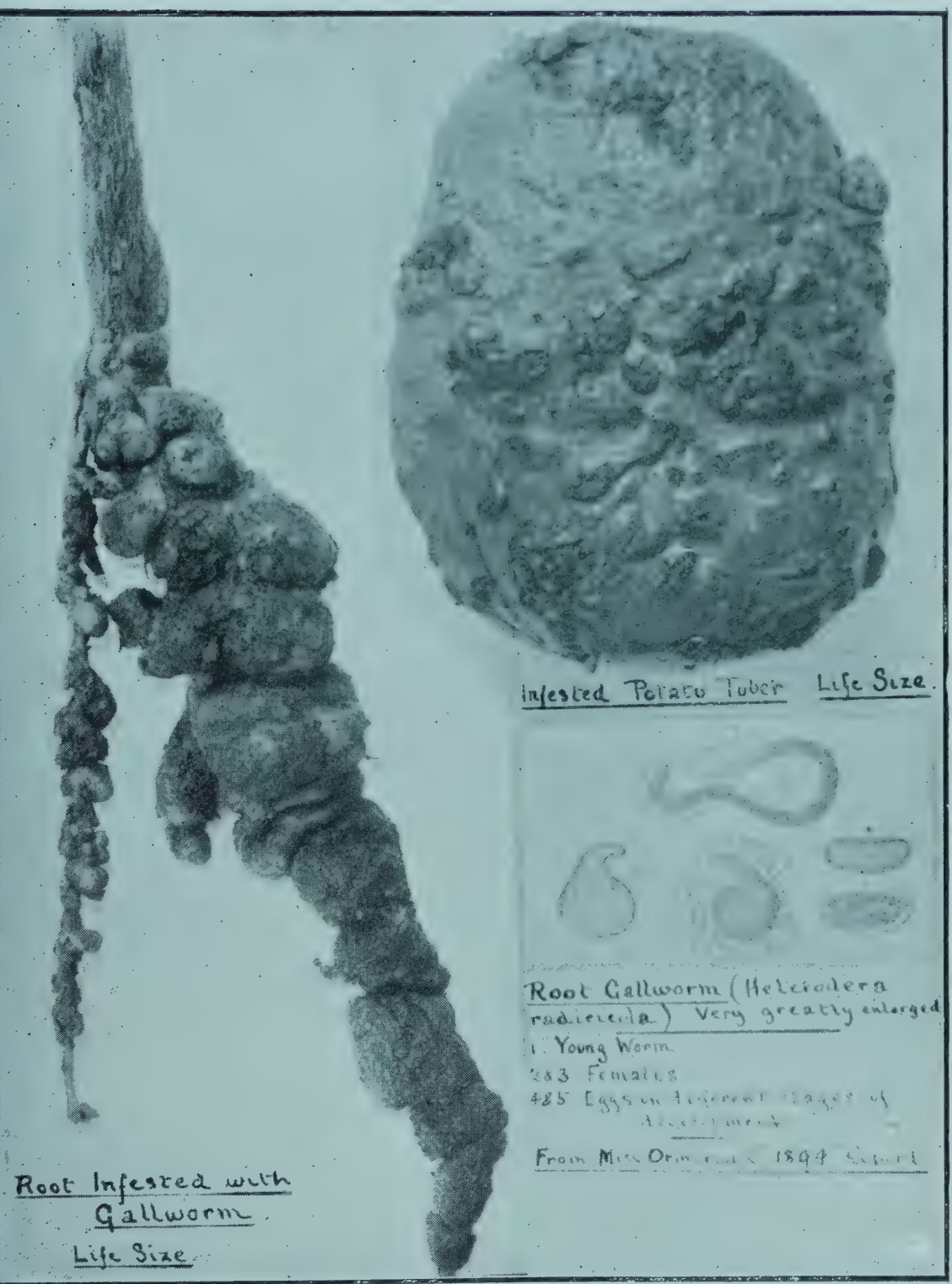
So little is known about these insects, that it is not possible to recommend remedial measures. It is probable, however, that when other crops come to be grown in rotation with tobacco, injury by these insects may become a thing of the past. With the present system of growing tobacco for two years on one piece of land, and then allowing it to lie fallow for

several seasons, the tobacco will always be liable to attack. It may be mentioned that when the grubs are present in great numbers in the soil, they are very manifest during ploughing operations, and much good would doubtless result from the use of " boys " to collect and destroy them as they are brought to the surface. If the numbers are seen to be very great, however, the wisest course, if practicable, would doubtless be not to plant tobacco on that piece of land.

Root Gallworm (*Heterodera radicicola*).—This is an important and dangerous pest which at the present time occurs very rarely in tobacco lands in Southern Rhodesia. It is, however, prevalent in several parts of the country in land that has been used for potatoes, and is likely to be introduced into tobacco lands if growers are ignorant of its dangerous nature, and the facility with which it may be transported, especially through the medium of infested seed potatoes.

The pest, and the injuries caused by it, are illustrated in the adjoining plate. The eggs are hatched within the swollen body of the female, who gives up her life in the process of reproduction. The young worms, shewn in the plate very greatly enlarged, are threadlike and provided at the anterior end with a spear-like instrument, which can be thrust out of the mouth opening and withdrawn. The newly-hatched worm is, of course, exceedingly minute, and not to be distinguished by the unaided eye. After wandering about on the plant tissues for some time, it comes to rest, and finally changes to an adult. The adult males remain slender, and measure about a twenty-fifth of an inch in length. The females swell up, and assume the shape shewn in the illustration. They become distended with eggs that hatch within their bodies.

Migration from plant to plant in the field is effected through the activity of the young worms, which may either voluntarily leave their host plant to seek a new home, or may be released into the soil by the decay and breaking away of the infested tissues of the plant. The young worms make their way into the rootlet of a new plant, by means of the piercing organ with which they are provided. In travelling from plant to plant, they seem to be much assisted by a soil of a sandy character, and it is usually such soils which become badly infested with the pest. As they are fond of damp ground, it is likely that many of the wet vleis of granite sand in different parts of



Tobacco Pests of Southern Rhodesia.
Root Gallworm.

the territory may become infested, and that the pest will flourish greatly under the conditions there provided. This is unfortunate, because these useful vleis occur on many good tobacco farms, and are very liable to be planted with potatoes for an early crop. Seed potatoes are, without doubt, the chief agent by which gallworm is transported, although nursery stock may also play an important part. Once the pest has been introduced to a farm, it is liable to be carried about by farm implements, the boots and feet of labourers and others, including animals and birds, by flood water, by drains, by irrigation, and perhaps even by the wind. Once a suitable soil has become infested with gallworm, it is likely to remain so as long as suitable plants are provided for its use. The variety of plants attacked is very great, and includes nearly all the crops that can be grown profitably in Southern Rhodesia, with the fortunate exception of cereals, including maize. The damage done to the plants is due, in the main, to the irritation set up in the tissues, which stimulates the formation of swellings or galls. The thickening of the tissues of the root interferes seriously with the functions of the plant, causing a feeble growth, wilting and frequently death. Seeing that remedial measures against this pest are hardly practicable on tobacco lands in this territory, it is obvious that great care is necessary to prevent the introduction of the pest. As already mentioned, seed potatoes constitute the most likely vehicle by which the pest may be brought to the farm, and on this account a potato tuber shewing galls caused by a gallworm is shewn in the adjoining plate, in order to enable growers to recognise the trouble, and to discard such infested tubers for seed purposes. Every endeavour is made in South Africa to prevent the spread of this trouble with nursery stock by means of the Government inspection of nurseries. Burning the seed beds acts as a precaution against infestation of the transplants, and should always be carried out, in spite of the fact that some growers express doubts as to whether the work and expense involved are justified. Land that has become infested should be discarded for tobacco and planted to maize or another cereal for several seasons.

Caterpillars.—Two species of caterpillars have been reported as injurious to tobacco in Southern Rhodesia. One is *Laphygma* (*Caradrina*) *exigua*, a cosmopolitan pest known

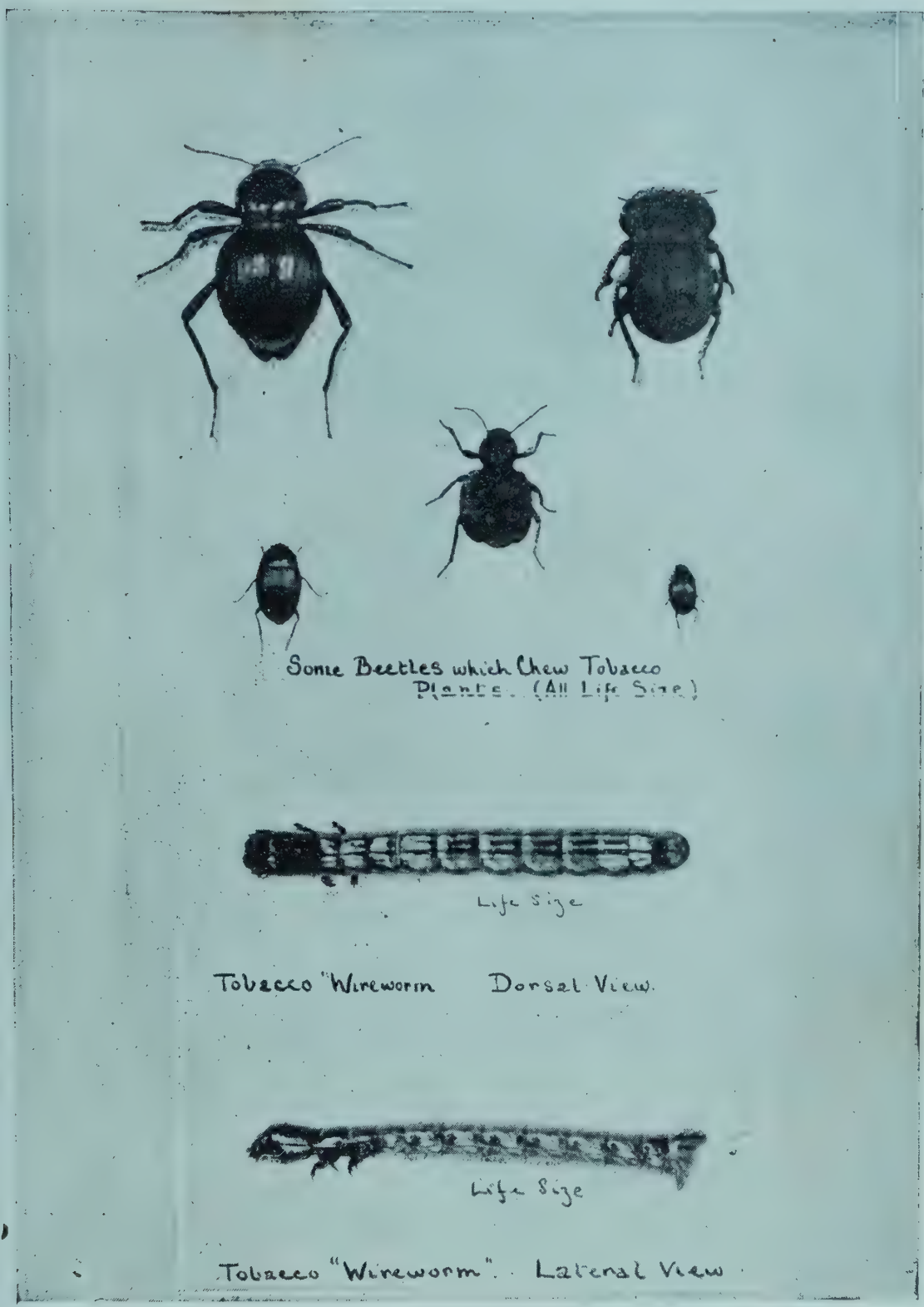
in the Transvaal as the "pigweed caterpillar," and in the United States as the "beet army worm." The other species has not yet been ascertained, but from descriptions furnished it appears to be one of the "semi-looper" caterpillars. The looper caterpillars do not progress by crawling in the ordinary way, but by bringing the hinder part of the body up to the fore part and arching the back, and then taking a grip with the hinder pro-legs, extending the fore part to take a grip further on. They are sometimes called "measuring worms." The semi-loopers are more or less intermediate between ordinary caterpillars and loopers.

The eggs of *L. exigua* are laid in clumps upon the plant upon which the caterpillars feed, and are partially covered over with hair from the body of the parent. They hatch in about four to five days, and the caterpillars feed up rapidly, changing to pupæ in as little as twenty days. Pupation takes place in the ground, and in the warmer portion of the year the moths may emerge in from nine days. The caterpillars feed on the foliage of the plants, but may also eat the stems and parts of the roots.

In ordinary years it has been found that these caterpillars can be kept under sufficiently by making the "boys" collect and destroy them during topping operations, but in certain seasons they appear in too great numbers to be left so long, and, in the absence of a supply of spray pumps, the whole labour on the farm has to be devoted to collecting and destroying the caterpillars. It, therefore, should pay the grower to keep a few pumps of the knapsack pattern on hand, in case of a bad invasion of caterpillars. In the parts of the United States where the "hornworms" constitute an annual tax on the production of leaf, machines for distributing dry Paris green and for spraying are a necessary part of the grower's outfit. Knapsack pumps may be purchased in Rhodesia for from 65s. upwards.

Probably the most suitable spray is :—

Paris green, 1 lb.
Fresh slaked lime, 2 lbs.
Water, to 160 gallons.



Insect Pests of Tobacco in Southern Rhodesia.

This will not render the resulting tobacco poisonous or inferior in any way, but it will probably be best not to spray within a fortnight of reaping the leaf, thus leaving a wide margin for safety.

The Budworm. *Chloridea obsoleta* (*Heliothis armiger*). —This is a cosmopolitan insect that attacks a variety of crops, including cotton, maize, tomato, etc. In America it does damage to tobacco by eating into the opening buds, and later by attacking and boring into the seed capsules. The insect occurs in Southern Rhodesia, but injury to the buds has not been observed, and injury to seed capsules, although common enough, is at present of no great moment, as seeds are not collected in this country. The reason for the immunity of the buds is not apparent. It may be that the insect has not yet contracted the habit, but may do so later, or that its enemies are more effective here than overseas. It is noteworthy that it has not yet been observed in the tassels of maize or in tomatoes within our borders, although these are its favourite feeding places in America and in Cape Colony. The remedy for "budworms" used in America is a mixture of a half teaspoonful of Paris green with a quart of finely ground maize meal. This is sprinkled on the buds from a can perforated like a pepper canister, and renewed frequently, especially after heavy rains.

Beetles.—Several species of beetles eat the foliage and gnaw the stalks of tobacco in this territory, especially when newly planted. The beetles are very dissimilar in appearance, but almost all belong to one family, the *Tenebrionidæ*. The beetles of this family are very lacking in popular names, the "tok-tokje" being probably the most familiar to South Africans. Beetles belonging to the following genera have been observed or reported to damage tobacco:—Zophosis, opatrum, gonocephalum, psammodes (tok-tokje), dictha and anomalipus. Of these, the most to be feared are zophosis and opatrum. These beetles will apparently gnaw any part of the plant within reach; they are not, however, provided with feet adapted to clinging to aerial foliage. It is probable that the damage is done almost entirely to newly-set-out plants, which are naturally in a checked condition, or to plants suffering from drought. Strong freely-growing plants appear to be almost exempt from attack, or at least to noticeable injury. It has been noted

that deeply-set plants, of which the growing heart is well underground, escape serious damage even where the beetles are abundant and hungry for food. The beetles eat the exposed part of the plant, which consists of the ends of a few leaves, but do not burrow more than about half-an-inch underground. The general opinion is that the deeply-set plants grow quite well once a good start has been obtained, and, although in going over a field shortly after planting, half the plants may appear to be missing, a few weeks later the grower may be able to congratulate himself on an excellent stand. Plants of which the heart is above ground are apt to be severed through the stems, and are then of little use, for although a plant may grow up from a sucker, the resulting leaf is likely to be disappointing.

The use of grass dipped in cutworm poison is efficacious in destroying opatrum, and has been reported to be effective against zophosis. All these beetles are fond of sweets, but the larger species are probably best destroyed by hand if they prove troublesome. Opatrum has a propensity for gathering under heaps of rubbish, and by placing heaps of inflammable rubbish about the fields, many of the beetles may be destroyed by burning in the earlier part of the dry season. The genera of the beetles figured in the plate, reading from left to right, are psammodes (tok-tokje), anomalipus, dictha, and zophosis (2 species).

Large Cricket.—This insect is sometimes a troublesome pest of tobacco. It is undoubtedly chiefly associated with this crop because of its preference for light, sandy soils, and not because of any special preference for tobacco. The adult insect is shewn in its natural size in one of the plates. The adult or fully-winged form has been collected from December to March, but immature forms, in which the wings are not fully developed, also do damage.

The insect's mode of attacking plants is to sever the leaf and drag it to its burrow. In order to get the leaf into its burrow, it is rolled up in a way that stimulates speculation as to how the operation is performed. The cricket seems to lurk within the rolled leaf in the ground, and can be dug out easily enough inside its self-made house.

The following poisoned bait is reported to be effective against this pest in the Transvaal :—3 lbs. bran, green grass or lucerne, ½ lb. sugar or treacle, and one dessertspoonful arsenite

Tobacco Pests of Southern Rhodesia. Field of Tobacco injured by Stem Borer.

of soda or Paris green. As a rule, however, they are dug out by hand. The natives are fond of these crickets for eating purposes, and take kindly to the work of capturing them.

Grasshoppers.—Several species of grasshoppers attack the tobacco in the seed beds and in the field, mostly in the earlier part of the season. When serious, they can be destroyed by spraying, as for caterpillars, with an arsenical preparation. Transplants can be dipped in poison as far as the roots as a protective measure.

The Cigarette Beetle (*Lasioderma serricorne*).—Stored tobacco in Rhodesia is very much subject to attack by this cosmopolitan insect. The whole life of the beetle is passed in the tobacco, and, under favourable conditions, the rate of increase is very rapid. Bales of tobacco may be ruined if left to themselves for a season or two. Cigarettes and cigars are also attacked. The different stages of the insect are shewn in the plate very much enlarged. This pest, of course, concerns the manufacturer rather than the grower, as the latter rarely wishes to hold his stock longer than necessary. The beetle can be destroyed by fumigation for 24 hours with carbon bisulphide, at the rate of 1 lb. to 1,000 cubic feet of space, but bales need to be opened up to enable the gas to penetrate. This gas is poisonous, and, when mixed in certain proportions with air, highly explosive, so its use calls for caution.

Triboleum Confusum.—This is usually a pest of grain, meal and other stored products, and it occurs over the greater part of the inhabited world. Rhodesia is apparently the only country where this pest has been recorded as attacking tobacco. It seems likely that the attack is generally dependent upon the proximity of infested grain or meal to the tobacco. The insect has not been found to breed in tobacco, but to attack it freely enough in the adult or beetle stage. Remedial measures that apply to the cigarette beetle will be effective in the case of triboleum.

Tobacco as an Insecticide.—Tobacco has a considerable value as an insecticide. It is used as a fumigant for greenhouses, in the form of snuff for dusting on the plants and as an infusion. It is effective against plant lice, thrip and other soft-

bodied insects. It is one of the earlier insecticides, and is increasing in popularity to-day. Some years ago its use was not much recommended on account of the difficulty of preparing a wash, etc., containing a given quantity of the active insecticidal constituent, namely nicotine. At the present time, however, there are a number of extracts on the market in which the proportion of nicotine is fairly constant, and by diluting these a reliable wash can be obtained. The home-made wash is very unreliable. It is usually prepared by soaking tobacco stalks and waste in water, at the rate of one pound of tobacco to one gallon of water, for several days. The water should not be boiled, as this drives off some of the volatile nicotine, and so weakens the wash. The darker and stronger the tobacco, the better the wash. In South Africa tobacco wash is recommended for use against the following important insect pests amongst others :—Woolly aphis on apple trees, green aphis on peach trees, black aphis on orange trees, cabbage aphis, black peach aphis, bean and pea aphis and onion thrip.

Mosaic Disease.—One of the most common diseases of growing tobacco is called " calico," or " mosaic " disease, because of the mosaic-like appearance of the light and green portions of the leaf. The disease causes the leaf to grow more rapidly near the veins than elsewhere, and thus become wrinkled and corrugated. A portion, or all of the plant, may be affected. Slightly diseased leaves are worthless as wrappers, and highly diseased leaves are of no value for any purpose. For many years the nature of this disease has been a mystery, and has been variously regarded as due to a fungus, as the result of an excess or deficiency of minerals in the soil, as produced by bacteria or induced by faulty drainage. Dr. Woods, of the United States Department of Agriculture, who has carefully investigated the disease, has arrived at the conclusion that it is due to none of the generally supposed causes, but that it is " due to defective nutrition of the young dividing and rapidly growing cells, due to a lack of elaborated nitrogenous reserve food, accompanied by an abnormal increase in activity of oxidising enzymes in the diseased cells." These are the same enzymes that prove so beneficial in the fermentation process later. The enzymes are liberated by the decaying plants or roots, and, if in excess, may enter the roots of young plants set

in the same soil, and induce a diseased condition, from which the plant will never completely recover. Plants with injured roots are more than commonly susceptible to attack.

The sowing of seed on fresh or burned plant beds, the avoidance of injury to roots in transplanting or in cultivation, and the making of conditions favourable to a steady, even growth, appear at present to be the only things within reach of the planter for the prevention or moderation of this condition.

Seed from diseased plants should not be saved, for, while the disease may not be carried in this manner, still an inherited tendency to this condition may be transmitted.

"Frog Eye," or Leaf Spot.—This disease is also called "white speck," because of its appearance in the form of small white specks in the tissue of the leaf. It appears to a certain extent in nearly all tobaccos, and does not do any large amount of damage. A few years ago cigar tobacco with this specking was in demand, but the style changed as soon as it was found possible to artificially produce this marking on any leaf. It is supposed by some to be caused by too much water at the tap root, and by others to be due to the presence of an excess of potash in the soil. It does not appear, however, that it is due to either of these causes, and is probably bacterial in its nature. This specking must be differentiated from the small white specks due to sun burning where there has been a particle of sand upon the leaf. No successful treatment is yet known.

Tobacco Mildew.—The most prevalent and injurious disease of tobacco in Southern Rhodesia is that which is variously termed by the planters "mildew," "mould," or "white rust." This disease makes its appearance in the form of a white, downy growth on the leaves, usually attacking the lower leaves of the plant first of all. It flourishes especially under conditions of dampness, crowding and insufficient air; hence it is generally more prevalent on Turkish leaf than on Virginian, but Virginian is also attacked to a serious extent. When it has once put in an appearance it spreads rapidly under favourable conditions, and if not checked is liable to ruin a considerable quantity of leaf. Leaves attacked by this fungus are quite useless for curing, and it is waste of time to reap them. They are said to turn black in the curing barn.

The usual method of checking the spread of the trouble is to remove and destroy the infested leaves as soon as noticed, and a sharp watch should be kept for them. This tends to check the dissemination of spores, which would otherwise be produced in great numbers and be carried to fresh plants. This method is stated to be effective as a rule, and is perhaps the most economic in a country where labour is cheap.

There is little doubt that spraying with one of the standard fungicides would be effective in checking the fungus, but the writer is not in possession of information concerning the use of fungicides on tobacco plants, and it is possible that copper salts would have an injurious effect on the final product.

House Burn.—House burn or pole burn in the tobacco barn is due to excessive humidity, and is very likely to be present during prolonged warm wet weather. The disease is first noticed by the appearance of small dark spots near the stem and mid-rib. The spots rapidly increase in size and numbers, and in a short time become confluent. Within forty-eight hours the whole leaf, and, in fact, all the leaves in the curing barn, may be affected and destroyed. The tobacco becomes very dark in colour and thoroughly decayed.

This decay is due to a bacterium that gains entrance to the leaf through any broken place or through openings made by fungus growths. Temperatures of 110 degrees stop its action, as also does the reduction of the humidity of the room. For this reason the disease may be controlled through regulation of the temperature and humidity of the room by means of fire and ventilation. The maintenance of a stove in the curing barn is always to be recommended. If there is no stove, small open charcoal fires may be started. All decaying leaves should at once be taken out of the barn and destroyed, to prevent infection of the remaining tobacco.

During wet weather this disease should be watched for. It will probably first make its appearance in the centre, or in the least ventilated portion of the room.

Moulds and Rots in Cured Tobacco.—After tobacco has been cured, different moulds and rots often do much damage to the stored tobacco. These will greatly injure or absolutely

ruin the leaf. The development of these troubles is due to the presence of too large a quantity of moisture in the leaf. The tobacco should be stored in as dry a condition as possible, and examined now and again to see that it does not absorb moisture from the air. A stove in the room to heat the air occasionally when the weather is wet will largely prevent the attacks. A room where the tobacco has once moulded should be thoroughly cleansed and disinfected before tobacco is again stored in it.

In the case of the black rot, cigar fillers may be put through what is known as a forced sweat, to kill the fungi and drive away the musty odour. The tobacco is allowed a large quantity of water, and placed in a warm room where it will heat rapidly, and in four or five days, in warm weather, will have reached as high a temperature as is safe. This sweat kills the fungi and if carried out thoroughly will also destroy the spores. The tobacco is not likely to be of the highest quality.

"Saltpetre."—The mould-like appearance that often comes over tobacco while curing and fermenting is called "saltpetre," and is due to a saline efflorescence caused by the presence of large quantities of salts in the leaf, as potassium, sodium, calcium, and magnesia. A light brushing and a spray of a four per cent. solution of acetic acid will remove this for the time.

Damage by Wind.—Heavy wind storms often break off the upper leaves of the plant and whip the lower leaves around on the ground until they are badly torn. The planting of tobacco in sheltered fields is the only measure that can be adopted against damage by wind. Where there are no natural windbreaks, the planting of large numbers of rapid-growing trees is to be recommended. A temporary expedient is to plant several rows of mealies (Indian maize) on the windward side of the field. Strips of mealies may also be sown at intervals of six or eight rods throughout the tobacco field. If leaves are accidentally broken off the tobacco plant when it is nearly ready to harvest, they may be gathered up and cured.

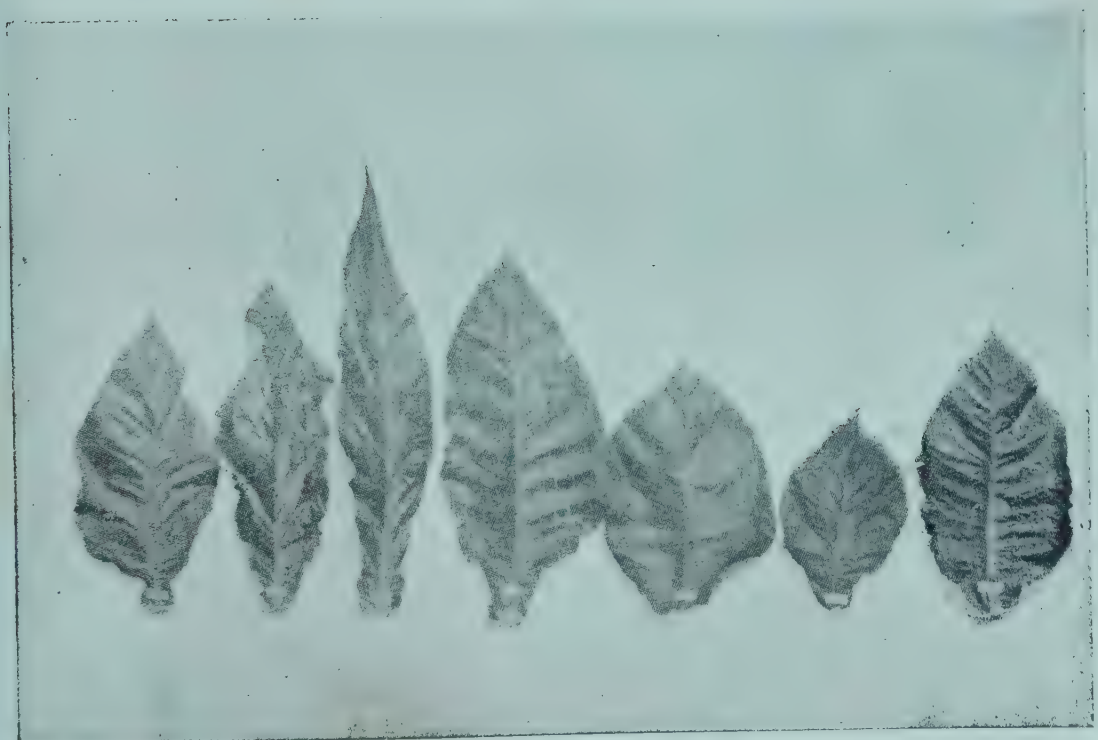
Hailstorms.—Even a very light hailstorm will injure the value of a leaf for wrapper purposes, and a very heavy hailstorm

will entirely destroy the whole plant. Where a plant has been badly broken it may be cut off near the ground and a sucker left to develop a new plant.

In some localities in Europe a method of breaking up hail-storms and preventing damage to the vineyards is practised. It consists in the simultaneous discharge of many cannon that have previously been placed at different points in the district. When this practice has been fully tested and its merits more fully determined it may be feasible to undertake it in the more thickly settled tobacco districts.

Throughout America certain companies will, for a premium of about four per cent., insure the tobacco crop against damage by hail or wind. The amount of the damage is usually determined by a committee of non-interested tobacco men, who are appointed for the special case, and are remunerated for their services by the insurance company.

Tobacco Damaged by Hail, at Chudleigh Farm, Marandellas.



Differences in Characters of Leaves from Plants of the same variety of Tobacco.

CHAPTER VIII.

The Prospects of Tobacco Culture in Rhodesia.

(By A. G. Stewart Richardson.)

In spite of various set-backs our leaf has made a name for itself, and the local manufacturing company, by its spirited competition with other buyers, has entirely revived an industry that shewed some signs of drooping not so long ago. However, the most optimistic grower cannot but recognise that the rate of progress made by the industry as a whole has been very deliberate in face of the extremely good prices given us by the buyers. I attribute much of this slowness to three principal causes :—(1) Present site of plantations, (2) scarcity and cost of native labour, and (3) lack of enterprise in trying the suitability of soils other than the stereotyped granite sands—this latter applies more especially to the Turkish types of tobacco.

I append a few notes—the result of personal observation on these three points—leaving such matters as different curing methods, fertilisers, etc., to the recognised experts on the subject, these details being much the same all the world over, while outside the immediate vicinity of the railways Rhodesia unfortunately remains more or less *terra incognito* so far as its soils are concerned.

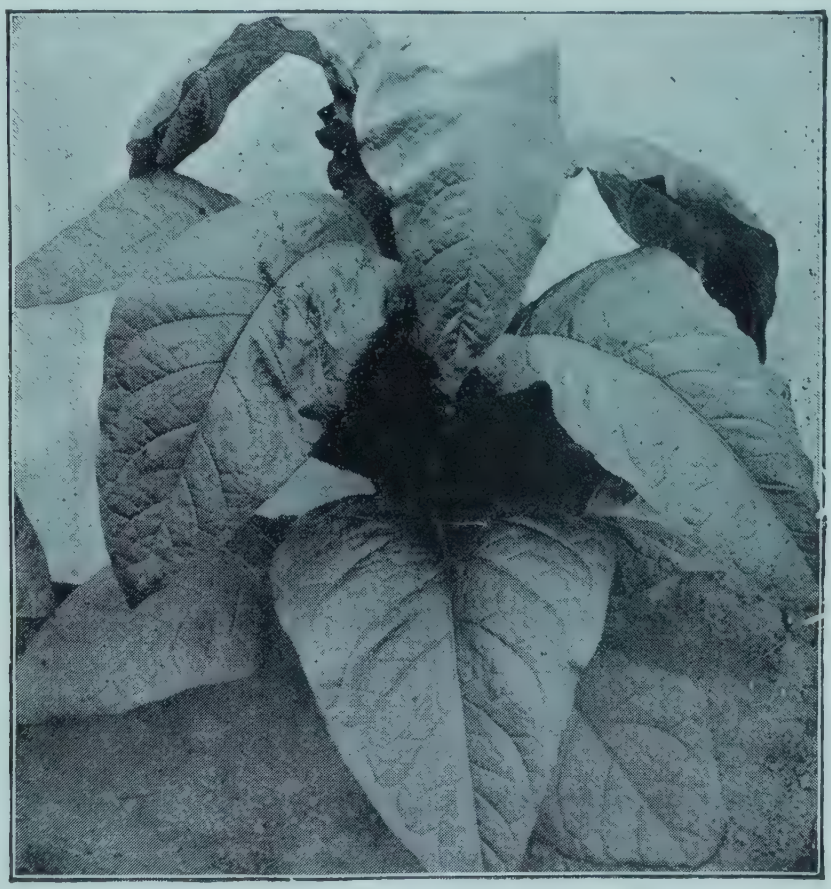
Rhodesia, as everyone knows, has so far been developed in the matter of railways, roads, etc., to suit the premier industry of the country—mining. The mines being the farmers' markets, agricultural development has, of course, followed the railway systems, which, built to connect the principal mining districts with the towns, have naturally followed our bleak high-lying watersheds as the cheapest route, and as naturally

have avoided the low-lying, sub-tropical, rich (and, incidentally, rather unhealthy) valleys lying principally to the north of the main watershed. The country thus developed, and on which practically all our principal farmers are established, while for the most part eminently suitable for cattle-raising, only grows a fraction of the crops that the undeveloped and low-lying portions of the country will eventually produce if given railway communication with the markets. Until then, however, such points as long and costly animal transport, nearly total isolation, and the undoubted prevalence of malaria, even though accompanied by double and treble crops grown with a minimum of trouble, are bound to weigh heavily with settlers, and cause land settlement to be practically confined to the watersheds, and the immediate vicinity of mines and railways.

On these watersheds granitic soils predominate, and as such soils will, with care, produce a bright leaf of high quality, tobacco is taking a prominent part in the crop routine. However, though the settler finds the climate to agree with him very well, it is doubtful if the tobacco finds itself in equally comfortable circumstances. Firstly, to produce a commercial quantity of leaf per acre—say 500 lbs. and upwards—on these high-lying granitic soils, quantities of costly fertilisers have to be used. Secondly, the rainfall, though good, is not so reliable as it is further north, nor do the soils withstand drought, or absorb excessive moisture so well as those of portions of the low veld. Thirdly, the spectre of early frost constantly confronts the grower who from any reasons whatever has to plant rather late. Fourthly, natives resemble tobacco inasmuch as they love veld where tropical and sub-tropical conditions make the struggle for a livelihood comparatively easy, and consequently they avoid the watersheds, and are found in their numbers on the low veld, and a good supply of native labour is essential to the tobacco planter.

Down on the low veld—in the great sandstone belts that traverse the country from Wankies to the Lomagundi—are valleys where tobacco can be grown under ideal conditions, means of access to the markets alone excepted. The soil for many years running will, in places, produce crops running as high as from 900 lbs. to 1,500 lbs. per acre, without any fer-

Virginia Leaf grown without fertiliser at Una Farm, Marandellas, on rich sandy soil.



From "Tobacco Leaf : Its culture, cure and manufacture."
Orange Judd Company, New York.

tiliser whatsoever. In place of stimulating growth, the planter, in an average season, has to try to keep that growth within bounds, and in some cases to effect this he ploughs shallow and plants very late. I have seen a crop of Turkish tobacco planted in December (two months too soon) grow into a jungle in which a man on horseback would be invisible, with middle leaves bigger than the rankest Virginian.

If our mines and settlement had occurred in districts such as these, our planters would by now be growing such quantities of leaf, and at so low a cost, that exportation to the home markets would have occurred long ago, to the benefit of all concerned, while, as things are, we are struggling to supply the comparatively insignificant South African demand, protected by the high import duty. Eventually, no doubt, as settlement proceeds, the low veld will be tapped by one or more railways, and when that occurs the industry will make giant strides. Cigar fillers and wrappers will then also undoubtedly be added to our present unvarying output of cigarette and pipe leaf.

The scarcity and cost of native labour has been referred to in a previous paragraph. Of course, all parts of the low veld do not carry a big native population, still labourers are, on the whole, more easily procured and at lower wages, when the vicinity of the mines is avoided, and the distance from their home is insignificant. Boys from the Zambesi valley, on their way south, pass through the sandstone belts, and are often willing to stop there.

It was laid down in the early days of tobacco growing in Rhodesia that only the poorest white granitic sands were capable of producing a good smokeable leaf. Everyone admits that if you fill up these poor hungry sands with expensive fertilisers you produce a small crop of very fine, delicate, and if properly handled, bright leaf.

In Rhodesia at present nearly all the tobacco is grown under similar conditions on similar soils—consequently there is no scope for blending. You might as well take two tins of the same quality nectar tea and, by mixing them, expect to get a new blend. Everyone is struggling to grow the canary-coloured bright leaf, and every crop contains half-a-dozen variations rung on this change.

Some of the most aromatic tobacco produced in this country was grown on a patch of stiff, grey Mopani clay (and it fetched a better price than the best bright Virginian). It was totally different in aroma and smoking qualities to some leaf produced on deep sandstone alluvial not 200 yards away, and would no doubt blend admirably with the latter. So long, of course, as the demand for bright Virginian is bigger than the supply, people will neglect other types, but the day must come when buyers want more than colour to mix with their inferior dark types of leaf. When that time arrives, Rhodesia can fill the gap—but our leaf will not all be grown in granite sand.

We used to be told that goat and sheep manure was fatal to all classes of tobacco. Now we know that for the grower of Turkish tobacco such manure is absolutely invaluable. There are probably hundreds of equally important re-discoveries to be made, and made they must be, before the industry reaches the level that most of us interested in its development hope and expect it to attain.

Tobacco Plantation, Bellevue Farm, Mazoe.

CHAPTER IX.

Notes on Tobacco Growing and Curing under Local Conditions.

(By C. S. Jobling.)

The following remarks are the outcome of seven years' experience and observation as a tobacco grower.

Virginia type of tobacco only will be dealt with in this chapter, having in view the production of "bright" or yellow leaf.

Soil.—The first essential is suitable soil. This must be chosen with regard to its adaptability in two respects, viz., physical characteristics as well as chemical constituents. The soil particles must be comparatively large, thus rendering it open and porous in texture, as well as capable of rapid draining. In other words, the soil must be of a sandy nature. Generally speaking, the poorer types of sandy soil are preferable. These are usually derived either from granite or sandstone. The experiences of the writer are confined entirely to the latter class. It may be said that the poorer the soil the brighter the leaf, though it will readily be understood that a degree of soil poverty can be attained which will preclude the possibility of obtaining sufficient weight per acre to make the crop a payable one; but this much can be said for such soils, that they may be enriched by the application of artificial fertilisers. On the other hand, if heavy rich soil is used, the results will always be disappointing, and the product will only be saleable at very unremunerative prices.

Seed Beds.—Too much stress cannot be laid upon the vital importance of giving these great attention. A good supply of healthy plants is half the battle. A continual succession of beds should be planted so that a regular supply of plants may be ready for planting out from about 1st November up till 10th

January. All beds should be insect-proof. A good bed is made by building a single brick wall all round, three bricks high. Lime mortar should be used, not dagga, as the latter washes out during heavy rains. A convenient size is 100 feet long by 5 feet wide. One and a half tablespoons of good seed will be quite sufficient for a bed of this size, and under ordinary circumstances it will produce enough plants for about 2½ acres. It is advisable, however, to provide at least double the number of plants which it is thought will be required. The beds should first of all be soaked to a depth of three or four inches, and should then be burned by means of an open fire. Mealie cobs make the best fuel for the purpose, but dry tobacco stalks from the previous year are also useful, and failing either of these, trash of any kind or small brushwood may be used. The soil should now be hoed to a depth of not more than three inches, all lumps broken, and the surface raked as smooth as possible. It is now ready for seeding. In planting, the quantity of seed above mentioned is thoroughly incorporated with 10 lbs. of S.A.F. Co.'s fertiliser, and the whole distributed as evenly as possible over the bed. It is then watered with the ordinary watering can fitted with a fine rose. The seed is not raked in or covered in any way, the spray from the watering can being sufficient to effect all the covering necessary. The bed is then immediately covered to the depth of about an inch with cleaned thatch grass, and the cloth covering stretched over the top; all subsequent watering being done through the cloth. From about the fifth day, a careful watch is kept for germination. As soon as this has taken place, and the tiny rootlet is seen bending downwards, the grass is removed, and an extra thickness of cloth put over the bed to keep off the sun's rays. At this stage the surface of the bed must be kept continually moist, and within two or three days the plants will be sufficiently developed to shew up green over the whole bed. One cloth is now removed, the other remains, and is never taken off, except for weeding purposes, until the plants grow right up against it, which will be in about six or seven weeks from planting. It must then be removed, in order that the plants may harden, and get accustomed to the sun before transplanting. It is a good plan to return the cloth every evening, removing each morning: this prevents moths gaining access to the beds at nights, and there depositing their eggs.

Transplanting and Treatment in the Field.—Contrary to the opinions expressed in most American works on the subject, I am a firm believer in a large plant; it can hardly be too big, in reason, so long as it is healthy, and has not been checked in the bed. Colour is the best guide in this respect. A pale yellow, sickly-looking plant rarely makes satisfactory growth in the field. The seed bed is well soaked before beginning to draw plants, so that they come out easily. The tap root of each is snipped off when taken from the bed; they are then packed in boxes, and carried to the field. The usual planting distance is 3ft. by 3ft. The rows are marked off by a home-made marker, which is drawn by a horse, and marks four rows at a time. The field is marked both ways. This saves a lot of time in planting, as the exact spot for each plant is clearly shewn wherever one mark intersects another; and, further, it permits of cultivation both ways subsequently. Planting pegs with iron points are used, and there is always difficulty in teaching new "boys" to tighten the plants properly. The tendency is to tighten them at the surface, and leave the root hanging in a hole. Plants treated like this will stand still for weeks, and, unless the weather is favourable, will die. The soil must be pressed firmly against the roots. Unless the weather is very dull and showery, the soil is heaped round the plant when planting to protect the heart, to be removed about the third or fourth day, when the roots have struck.

As soon as the plants are well established, cultivation should begin, and it cannot be repeated too often. A horse hoe may be used while the plants are still small, but if a supply of labour is available, I prefer hand hoeing. This must be done at intervals, both for the purpose of destroying weeds and conserving moisture, until the blossoms appear. Topping then becomes necessary. It is difficult to describe on paper just how this should be done; any number of leaves from eight to sixteen may be left, dependent upon the size and robustness or otherwise of the individual plant. At the same time the tobacco should be primed. By this is meant the removal of the bottom three or four leaves, which are usually damaged or mis-shapen.

Suckering will next call for attention; this will be necessary about a week or ten days after topping. By this is meant the breaking off of the young shoots which spring from each

leaf axil, in an attempt to form seed heads in place of the main stem which has been removed by topping. They may be much more easily removed while young and brittle than if allowed to become older and more fibrous. Suckering may be done once, twice, or a number of times, dependent upon the nature of the leaf. The object is to cause the sap, which would naturally have gone to form seed, to flow into the leaves and give them more body. If the leaf has a tendency towards heaviness, it will be well to sucker only once, afterwards permitting the suckers to grow up and blossom. Indeed, in some cases it may be wise not to sucker at all.

Harvesting and Curing.—The bottom leaves of the plant will be the first to mature. Indications of ripeness vary in the different classes of leaf. In the case of really light leaf, harvesting should commence when the colour becomes a light yellowish green : this type of leaf will never crack when bent double between finger and thumb. The heavier leaf will become spotted and break clearly when pinched up in the fingers. It will be found advisable not to commence reaping before 9 a.m., as in the early morning light it is difficult to distinguish the ripe leaves from those which are green. The leaf is loaded on wagons and carted to the barn. It is then tied on sticks (in the shade) in bunches of three, and hung at once in the barn. The barns used are 16ft. by 16ft. and 6 tiers high. A barn of these dimensions takes about 1,000 sticks, which will yield on an average 1,000 lbs. of cured leaf. It is impossible to lay down a definite set of instructions for curing; practically no two barns are treated exactly alike ; so much depends upon the varying degrees of ripeness, lightness or heaviness of leaf, and atmospheric conditions. Successful curing can only be learnt by experience, and close attention to detail. The following is roughly the treatment applicable in the case of a barn of light, ripe leaf.

Immediately it is filled, the door and ventilators are closed, fire lighted, and the temperature raised to 90 degrees, at which point it remains for three hours. It is then raised as follows :—

to 95 degrees for 3 hours, then
100 ,, ,, 6 ,, ,,
105 ,, ,, 3 ,, ,,
110 ,, ,, 9—12 hours

or until the leaf is yellow enough to commence drying off. The temperature is then quickly raised to 120 degrees, when door and ventilators are opened wide until the thermometer drops to 110 degrees. This is repeated about six times, after which the barn is held at 120 degrees for about two hours. It is then raised quickly to 130 degrees, and allowed by admitting cold air to drop to 120 degrees. This is repeated three or four times. Then it is held at 130 degrees for two to three hours, with ventilators slightly open. Following this, it is raised 5 degrees every two hours until 150 degrees is reached, at which point it remains for about six hours. The critical stage is now passed, and it only remains to dry out the leaf and kill the rib. The temperature may be moved up to 160 degrees and held there until the last twelve hours, during which it is kept at 175 degrees. The fire is then drawn, door and ventilators opened wide, and 24 hours allowed for the barn to cool off. It takes five days to cure a barn.

The main points to be observed in curing are, first to get the tobacco yellow. Moisture is necessary for this; none should be permitted to escape until the tobacco is yellow. Do not wait until the entire leaf is yellow, or sponging will inevitably follow. If the lower half of the majority of leaves is yellow, it is time to start drying. Go as fast as you can without splotching, but it is always safer to go slowly even at the expense of a little sponging, rather than too fast and cook the entire barn.

The leaf is now cured, but so dry and brittle that it will break into powder if grasped. It must be ordered or softened so that it can be handled without breaking. This is done by the use of steam, generated in a 400-gallon iron tank, and conducted to the barn in a pipe. This pipe goes right across the barn a little above the flues, and is perforated with small holes every three inches, on each side, thus distributing the steam evenly. Care must be exercised in ordering not to get the leaf too damp, or it will run dark in colour or even go mouldy. When the lower halves of the leaves, which first come in contact with the steam, are soft enough to grasp firmly in the hand without breaking, the tobacco may be taken out of the barn and bulked on the sticks in a close room, or preferably an underground chamber. During the night the moisture in the

tips of the leaves will spread through the drier parts; the whole bulk should be ready to take off the sticks the following morning and go straight to the baling press.

PESTS.—Leaf caterpillars and cutworms sometimes appear in the seed beds. These can practically be wiped out in one night by spraying with Paris green. The plants have been noticed each year to die off in the beds in circular patches from 6 to 18 inches in diameter. I can offer no explanation for this; but an application of fertiliser has a stimulating effect which appears to check it.

Hand picking has been found the only effective way of dealing with cutworms in the field, but only small patches have been affected. By far the most destructive pest is wireworm, which eats off the plants after they are put out in the field. No effective method has been found for dealing with this pest. Poisoning cannot be carried out, as it works beneath the surface. The experiment was tried of treating 10 acres with apterite, at the rate of 200 lbs. per acre, broad-casted and ploughed in. This treatment had apparently no effect whatever. Great damage was being done by a worm which locates itself in the stem of the plant, causing a characteristic circular swelling of the stem itself. The plant stands still and never makes any progress; only on rare occasions does it outgrow the effects of harbouring this pernicious invader.

In conclusion, the following observations may be made :— New land produces the brightest leaf. It is not advisable to grow tobacco more than three consecutive seasons on the same land, and preferably only two. The leaf gets darker each year. This is said of land which has been fertilised each season. It pays to use fertiliser, which assists the plants to make a quick start, as well as having a good effect on both quantity and quality of the crop. Two hundred pounds per acre of "Safco" is a satisfactory application : it may be broadcasted or harrowed in just before planting. Do not plant tobacco unless you are prepared to give it personal attention. It is not a crop which can be left to take care of itself. It is probably not wise to look too far into the future; but it may be said, with some conviction, that tobacco is to-day, and probably will be for some years to come, one of the most remunerative of our Rhodesian farm crops.

CHAPTER X.

Sumatra Tobacco: Hints to Rhodesian Growers.

(By Dr. C. J. Sketchley.)

In view of Sumatra tobacco now being grown by quite a number of farmers, a few notes on the subject from one who has grown this variety largely for over fourteen years in tropical countries, may be of interest.

Sumatra leaf tobacco is grown and used almost exclusively for the outer wrapper of cigars. It should be of a fine silky texture, very thin, tough, and elastic, and it must be essentially of good burning quality; shewing a white ash, burning evenly round the cigar, and it should hang on tenaciously until shaken off by the smoker.

Good Sumatra tobacco has little or no flavour, although in some countries it develops a flavour peculiarly its own, and is then used for blending purposes, as well as for wrappers. I have known cigars made from a blend of Sumatra, Cuban, and Zimmer Spanish tobaccos, with Sumatra wrappers, all grown on the same plantation, to fetch a high price on the London market. The reason for the great demand for Sumatra leaf for wrappers is, that while Havana leaves will only go from 40 to 60 to the lb. weight, Sumatra will give from 120 to 140 to the lb.; and, as each leaf of from 12 to 14 inches long will cut from 8 to 10 wrappers, it will be understood that for this purpose Sumatra tobacco is more economical than other tobaccos (although costing from 4/6 to 8/- and 10/- per lb.), whose burning qualities are not so good, whose texture is coarser and lacking altogether the elegant finish of the Sumatra covered cigar.

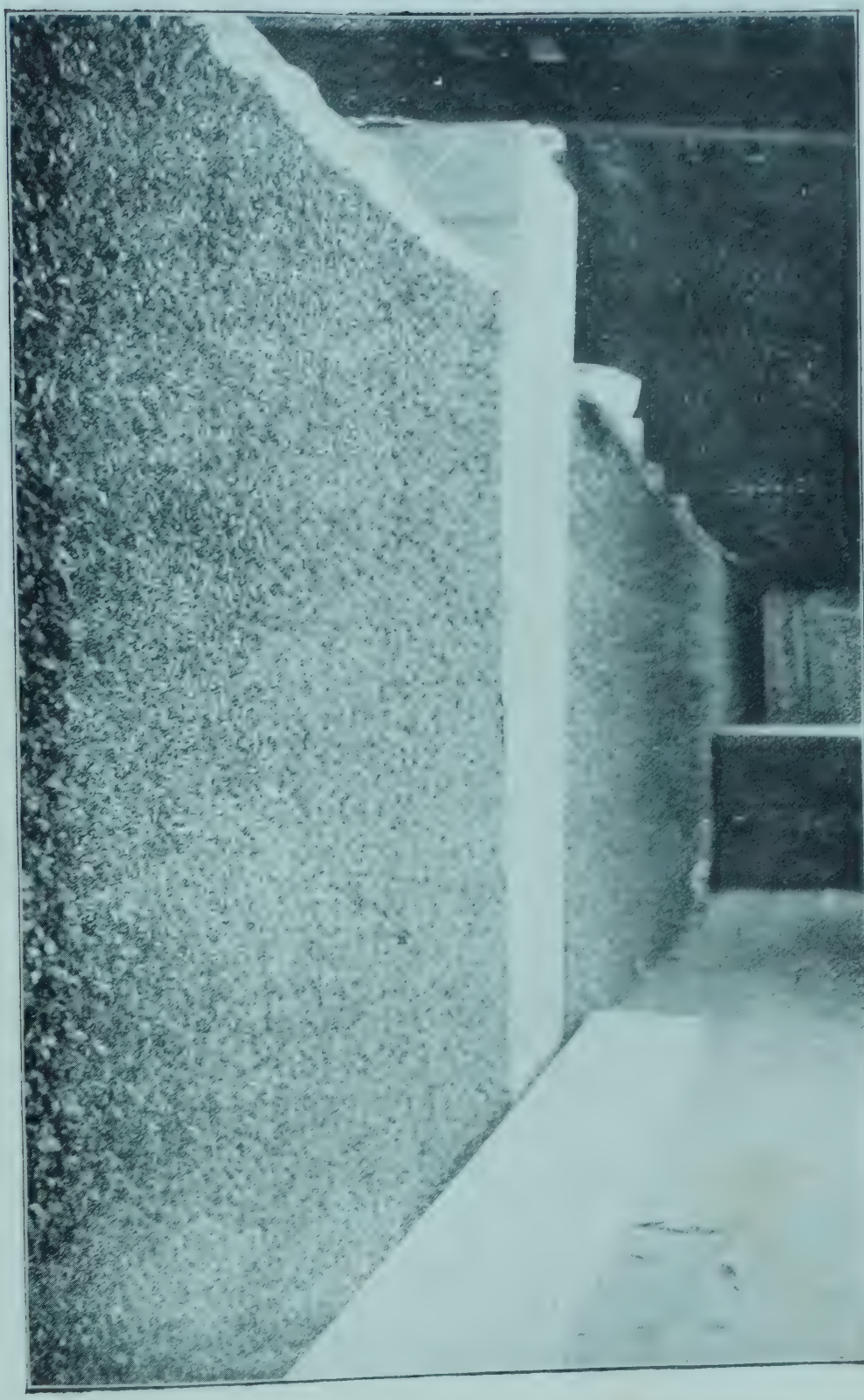
The origin of Sumatra tobacco is unknown, though it is stated that it is indigenous to Sumatra, and has been used by the natives there for ages. This is instructive, as it is always supposed that all tobaccos came from the American continent

originally. It is said that the small leaved Turkish tobacco was originally Maryland tobacco, which, from climatic causes and conditions, has assumed a type unlike any other tobacco. It is curious how tobacco introduced into a new country will assume in a few years a distinct type of leaf and aroma; in many cases quite distinct from the parent plant. I have proved by my own experience that Sumatra tobacco grown under tropical conditions several years in succession, from seed saved locally, has deteriorated in a remarkable manner as wrapper leaf, although it has improved in aroma and texture as a filler tobacco. Therefore, if the object was to produce first class wrapper leaf of an even quality, from year to year, it was found necessary to import the seed direct from Sumatra each year. It is quite feasible that, by selecting the best plants, and collecting the seed for a few years, a distinct type of Sumatra tobacco might be grown here, which would be very useful to cigar makers, if not of the finest type for wrappers.

I am inclined to believe that a finer tobacco could be grown here for wrappers from Sumatra seed than the Connecticut seed leaf, which is so largely grown for the purpose in America. But all these problems require to be solved, and this is, in my opinion, the work of the Government Experimental Farm. There are few men here who have any knowledge of cigar tobacco growing, and experiments by others are costly and unsatisfactory. My experience here for the last nine years is that Sumatra tobacco leaf thickens, and becomes very similar to the Java type. Java tobacco was first introduced from Sumatra, and although it fetches a much lower price in the markets than Sumatra, it is in fair demand for cigar fillers, and pays well to grow. I think it likely that Sumatra grown here will develop into this type.

It is quite possible that a high class fine leaf could be grown here on the system adopted in Florida and Cuba—that is, to cover the whole plantation with a framework of sawn timber or poles, covered with limbo or canvas, which has proved such a success in those countries: but it is needless to say the cost in Rhodesia would be prohibitive.

Sumatra tobacco loves a hot, moist climate and a rich leaf mould. Under favourable conditions it is a rapid grower. I have made seed-beds on the banks of tropical rivers, in rich sandy soil, with a temperature during the day of 80 degrees to



A Large Fermentation Pile, Ohio.

86 degrees F., and at night 76 degrees to 80 degrees F. Three weeks from sowing the seed, the plants were 5 inches high, and ready to plant out. Two months later the crop was ready to harvest, the plants being 6 ft. high, with an average of 18 to 22 leaves to a plant.

To grow a fine leaf, the plants must continue growing without a check—the more rapid the growth, the finer the texture of the leaf. One drawback here is that, as soon as the rains commence, the temperature falls. To attempt to grow a fine, delicate leaf during the hot dry spell before the rains, even under irrigation, would, I am afraid, be hopeless, as the production of a fine leaf depends chiefly on heat and a moist atmosphere.

I am now experimenting with seed kindly sent me by the Agricultural Department. I have enough plants to grow about two acres. One acre I shall "Safco" heavily; the other I shall leave to natural conditions. I shall plant on the richest soil I have on the river banks.

My method of growing Sumatra is as follows:—I first procure the best and purest seed I can obtain, preferably direct from Sumatra. To prepare the seed beds, I dig over the land and well burn it. Mealie stalks do very well, and should be piled 3 feet high, covering the whole of the land required. I then hoe in the ash, and rake it over evenly; I dress the land with a good application of "Safco," or other good fertiliser, and rake it in. I then lay out the beds 4 feet wide by 40 feet long, rake evenly and pat down the surface with a spade, hoe, or roll it. I then water it thoroughly, so that it is wet down 6 inches or so. Early the following morning, before the wind rises, I mix one dessertspoonful (not heaped up) of seed with an ordinary wash basinful of sifted wood ashes. These I mix thoroughly by passing several times through a sieve. I then sow evenly by sprinkling it broad-cast, going down the bed one way, and up the other, to ensure even distribution, for which the white ash is a good guide. I then roll or pat the surface firmly with spades, and cover it evenly with long dry grass about half an inch thick (care must be taken that the seed ends of the grass be cut off, or you will be raising a fine crop of grass with your plants). Water well over the grass two or three times a day. In five to eight days the seed will germinate, and as soon as it is seen through the soil cover it with

limbo, or, as I prefer, make a framework of sticks about 12 or 16 ins. high round the beds, and lift the grass on to the framework, to shade the young plants from the hot sun. The beds should now be watered three times a day—in fact, they should never be allowed to get dry. If any check occurs, a tablespoonful of ammonia sulphate in each 3 gal. watering can, applied every two or three days, will soon make a difference, and the plants which look sickly will assume a healthy dark green. If cut worms or other leaf eating pests give trouble, an application of arsenate of lead sprayed over the plants will at once rectify this trouble.

The plants should be big enough in four to six weeks to set out, and they should then be from 5 to 6 inches high. I may say here that it is a great mistake to put out plants when too small. A big strong healthy plant can stand a dry spell after planting, whereas a small undersized plant will simply be dried out. The land cannot be too well prepared by ploughing and cultivating. Ridging is now the fashion, but in any case the plants should be set in rows 3 feet apart, and 2 feet to 2 feet 6 inches apart in the rows. An application of a teaspoonful of "Safco" should be applied round each plant, or if ridged, it can be sown with an ordinary one-row mealie planter on the ridges. Constant cultivation is necessary, until the plants are 2 feet high, when all the labour should be hand work. The plants should be constantly watched for cut worms, caterpillars and other pests, as a leaf with holes is useless for wrappers. Suckering and topping must be done as with ordinary Virginia tobacco, but the topping should be left until the crop is a uniform height, say 5 to 6 feet, although perhaps $4\frac{1}{2}$ to 5 feet will be the maximum height here in most cases.

After topping, the plant rapidly matures, and should be harvested either by the single leaf system, or by reaping the whole plant. It is usual to leave from 16 to 22 leaves on each plant. If the whole plant is cut, it should be hung in the barn on sticks or wires, and the whole mass in each tier should be pushed close together, and left so for two or three days to yellow. It must then be spread apart for the air to circulate amongst the tobacco to dry it out. If the weather is too moist, or a rainy spell sets in, the tobacco is liable to get what is called "pole burn," a mould which forms on the leaf, but if

Dark Mahogany, Light and Lemon Wrappers.

small fires 10 or 12 feet apart are made under the tobacco, it will soon disappear. This can be prevented by a timely application of the fires, which need consist only of five or six small sticks each.

The leaves can be stripped as they ripen on the plant, by the leaf system. The leaves are then placed on the ground on dried grass, in layers about 10 to 12 inches high, and covered again with grass, for two or three days, when they can be tied in bundles and hung in the barn to dry. When the mid rib is thoroughly dry and crisp, the tobacco is ready to strip and sort. Leaves of 10, 12, 14, 16 and 18 inches each should be kept separately. They should then be graded, each length being sorted into three shades, viz., light, medium, and dark, each shade being kept together. They can then be stacked in bulk to ferment, and here the art of the experienced grower comes in. If bulked too moist, too high a fermentation will set in; and if the tobacco is not moist enough, it will perhaps not ferment at all. A piece of the floor is marked off for the stack, which should be from 8 feet to 12 feet wide, and of any length. A number of logs are laid on the ground, and these are crossed by smaller sticks, which are covered a foot or so with sweet dried grass. If the grass is covered with a wagon sail, all the better. The tobacco is tied in bunches (hands) of 12 or 14 leaves with a piece of "tamba" or twine, and then laid in rows on the sail, butts out, in two rows, the tips of the leaves just crossing or overlapping. The next two rows are then placed in position, butts to butts, and so on until the first layer is laid the whole width of the stack. The next layer must be laid from side to side in the same manner, but crosswise, the bunches pointing from end to end of the stack, and so on, reversing each layer until the stack is complete. The larger the stack, the better the tobacco will be, if in proper condition, up to 10 tons. It will be necessary to place a thermometer in the stack every 3 or 4 yards, about half-way up the stack from the bottom, in a hollow bamboo, or a long box made of laths. The thermometer can be pushed in with a stick, and can be drawn out by a string tied to it. The stack should be covered with a wagon sail; in tropical countries rush mats are used. If the temperature should rise above 120 degrees F., re-stack the tobacco on an adjoining site, in the same way as before, when the top layers will be at bottom and bottom at top, ensuring

an equal fermentation. If the stack does not rise above 120 degrees, then let it stand until it cools down to the outside temperature, when it is ready to bale and ship.

When shipping tobacco to England, I have found it better to handle it in this manner, and ship it direct to tobacco "handlers," who re-sort the leaf into the proper number of shades and grades, re-bale it, and prepare it for the auction sales. In no case have I paid more than ¾d. per lb. for this work.

To attempt to sort the leaves into the requisite number of shades, as is done in Sumatra by expert Chinamen, with the labour we have at command here, would be simply hopeless, as something like sixteen shades and grades are required. About sixteen years ago, there was a craze for a dark olive green tint. This was obtained by harvesting the tobacco about two weeks before it was ripe, but the most desirable colour is a bright cinnamon brown, as all leaf darkens more or less when damped for wrapping cigars. Some of the drying sheds used in Sumatra are enormous structures, 150 feet by 150 feet being an ordinary size, and always built of poles and grass. Some of the companies growing tobacco there have a capital of £250,000 to £350,000, and pay dividends as high as 75 per cent. I should be very pleased to see Sumatra tobacco a success in this country. We have made both Virginia and Turkish tobaccos a decided success, and why not Sumatra, even if it is not of the highest grades, which would be expecting too much.

In closing, I would impress upon all farmers who are trying Sumatra, to remember three things :—

(1) Keep the plants growing as rapidly as possible from sowing the seed to harvesting.
(2) Don't allow a grub or insect pest to injure a leaf.
(3) Use great care in cultivating the crop while growing, during harvesting operations, and when handling the leaf at all times, as broken and worm-eaten leaves are useless for cigar wrappers.

CHAPTER XI

Rhodesian Tobacco : Prospects of an Australian Market.

By Eric A. Nobbs, Ph.D., B.Sc. (Director of Agriculture).

Every outlet for our rapidly increasing production of tobacco demands attention whether it be small or considerable, prospective or immediate. To this end I carried with me to Australia samples of our unmanufactured leaf of different grades supplied by the Warehouse as characteristic of large quantities, also samples of pipe tobacco and cigarettes manufactured from Rhodesian leaf by the Tobacco Company of Rhodesia and South Africa, Ltd., of Bulawayo, and three coast firms. The object was to ascertain the prospects of a market in Australia, to introduce our tobacco to the notice of manufacturers and dealers and to learn their views thereon. The accompanying notes will convey the impression gained.

I called upon seventeen firms of manufacturers, tobacco importers, dealers and retailers, enquiring as to the prospects for Rhodesian tobacco, exhibiting my samples, calling attention to our products and discussing generally with them conditions of the trade.

I have brought together the opinions expressed to me in the following notes, and I may say that I found a very general agreement in the views expressed.

A number of the larger tobacco manufacturers are understood to be united in a trust, although this is denied by them. The so-called combine appears to be mostly concerned in cigarettes, and keenly interested to secure suitable leaf which it is having increasing difficulty each year to obtain. If this alliance of big manufacturers can be induced to take our tobacco, which it seems is only a question of prices, and is not unlikely, it would want it in enormous quantities.

Other manufacturers are experiencing difficulty in getting bright cigarette cutters and are on the outlook for fresh sources of supply, but at present the difference in price is too great. These remarks refer only to our bright leaf; there is little prospect for the sale of our darker samples and heavier pipe grades of leaf.

Both the raw and manufactured tobacco are much admired on their merits and also as forming an attractive novelty. They agreed that to establish its popularity systematic and active advertising was required. All our manufactured lines elicited admiration on account of brightness, aroma and combustibility, in which they appear far to excel the generality. Competent judges refused to credit the absence of scents and flavouring essences, even when this was distinctly indicated on the labels, but were always struck by its characteristic flavour. The Invicta brand, manufactured by Messrs. Hermann and Canard, though but lately introduced, is already established on the market and was very favourably commented upon by the firms handling it, both wholesale and retail, and is likely to become quite popular when it is better known.

Importers and retailers were much interested in the different brands of cut tobacco I was able to shew them, and expressed a desire to communicate with the manufacturers, particulars regarding whom I supplied. The pipe tobacco which is most popular in Australia is that which sells by the million at 10d. or 1s., put up in 2 oz. tins. There is evidently a better prospect for the sale of our pipe tobacco than for our cigarettes or raw leaf and a large business is likely to grow up. The landed cost, including the duty of 2s. 6d., should be so fixed as to enable it to be retailed at 1s. per 2 oz. packet. Further, it was made evident that brands of cut tobacco must be packed hermetically, and that the labels of different strengths should be of different colours or tints to facilitate handling. If entire freedom from flavouring essences of all kinds can be guaranteed it is well to emphasise the fact on the labels. Manufacturers should send full ranges of their various lines to their representatives in Australia and meet their peculiar requirements indicated above as far as possible, even supplying them, if desired, with an exclusive blend. It was suggested that to attract attention to our tobaccos specially low

Tobacco at Sleamish Farm, Mazoe.

prices should be quoted for the first couple of consignments or for the first few months, so as to get these unknown brands on to the market, making it quite clear to the firms concerned that this is only a temporary measure.

Plug tobacco seems to be largely consumed in Australia, and enquiries for this type from Rhodesia were made. Certain peculiar standards as regards size and weight are insisted upon. The want of a light and bright plug is specially emphasised. It seems likely that there is an outlet for our medium and dark leaf in this direction. Plug tobacco enjoys the advantage of the preferential rate and requires a minimum of labelling and packing. Australian plug tobacco is highly flavoured with all sorts of ingredients to try to impart to the inferior leaf the aroma which ours naturally possesses.

As regards cigarettes, there is no preferential tariff, the rate on all importations being 6s. 6d. per lb. The chief demand in Australia is for cheap lines with a brilliant label outside and an attractive picture inside. There is, therefore, likely to be difficulty in introducing and establishing Rhodesian cigarettes whatever the quality may be. The opinion seemed to be that our cigarettes were not able to rank with the highest class of cigarettes de luxe, nor, on the other hand, to replace the popular favourites, especially at present prices, but that under certain circumstances a good business might be built up.

Rhodesian cigarettes to retail at 9d. or 1s. for 10 would have to be offered at low prices to the trade, and they would need to be got up in different and more ornate style—preferably in boxes. It seems unlikely that this can be economically done in Rhodesia, as packing materials, etc., have first to be imported. Even then the sale would not be large, as the great demand in Australia is for the cheap local article, familiar, well advertised, and attractively packed. The quality of our Rhodesian cigarettes was warmly approved, but quality seems to be a subordinate consideration in Australia.

The economic tendency of Australia is towards the importation of raw produce to be worked up by Australian labour for Australian consumption, especially as regards cigarettes

and cigars, less so as regards our pipe tobacco and plug. Raw leaf as graded by the warehouse can, of course, only be sold to the manufacturers. These are limited in numbers and include some very large and a few small firms. Rhodesian bright leaf would compete in Australia as in South Africa with the Virginian type from the United States, and with locally-grown leaf. For our pipe qualities and our short medium bright leaf there is no prospect of a market at the Rhodesian price of 1912, 8d., 10d., and 1s. 2d. per pound. Small leaf with a large proportion of stalk entails too much expense in handling under Australian conditions of dear labour. Our heavier leaf resembles the best class of Australian grown air-cured tobacco, which of course has no protection of the tariff, and is therefore precluded from competition. Our bright leaf—cigarette cutters—which at the 1912 sale in Salisbury fetched from 2s. 9d. up to as high as 3s. 4d. is comparable to leaf from the United States, which was bought last year at 1s. per pound in Australia, and next year is likely to be dearer, perhaps 1s. 3d. or 1s. 4d. Tobacco of this class is in great demand, and, if prices suited, would find a ready sale amongst Australian manufacturers, but leaf which at our 1912 sale fetched 2s. to 3s. is at present bought in the United States for 10d. to 1s. As regards duties, America and Rhodesia are on precisely equal terms in Australia for this leaf. The price is constantly rising in the United States. It is recognised in Rhodesia that our prices must fall somewhat as supplies increase and the industry approaches normal commercial conditions. Ere long leaf of this type may therefore become saleable in Australia. Rival manufacturers agreed upon these points and did not regard business as out of the question by any means—indeed, they were enthusiastic as to the merits of our leaf. The difficulty in getting American leaf of the quality desired and similar to ours is increasing year by year, and is felt over the whole world. It would probably be best to treat Rhodesian bright leaf as an altogether new line and to introduce it as such, purely on its own merits, which are recognised, and on its own characteristic flavour and aroma. Turkish tobacco elicited little interest and did not seem to be known or appreciated. A small quantity of this type is grown in Queensland. Curiously enough all the manufacturers assured me that there

Tobacco at Uplands Estate, Marandellas.

Tobacco Field and Flue Curing Barns, Uplands Estate, Marandellas.

would be no market in Australia for our brands of our pipe tobacco and cigarettes made in South Africa, but the evidence and experience of importers and retailers is otherwise.

On my arrival in Australia I was faced with some difficulties regarding the duty levied on different classes of tobacco amongst the samples I took over. This raised the whole question of the preferential rates granted to South African tobacco, and on this subject I had several interviews with the Federal Minister for Trade and Customs, the Hon. Frank G. Tudor, and with Mr. Lockyer, the Comptroller General.

There appears to be some disparity in the terms used in the Customs Tariff (South African Preference) Act, 1906, and the Customs Tariff of 1911. As it was desirable to secure a clear ruling on the point it was arranged that I send certain samples to the Customs authorities and receive their decision as to classification. The samples referred were as follows :— Dark leaf suitable for pipe, medium bright short leaf, cigarette cutter bright leaf and Turkish leaf; also Connaught and Kingsdown cigarettes in packets and tins of cut pipe tobacco of Matabele mixture and Ambrosia brands.

As a result of these enquiries it appears that under the present interpretation of the tariff cigarettes do not enjoy the preferential rates. South African tobacco leaf pays 2s. 6d. on being imported with a preference of 1s.; and if manufactured would have to pay the excise of 1s. in addition. Such tobacco in bond enters Australia under Item 21 from any part of the world at 1s. 6d. in bond plus 1s. excise on manufacture. This is therefore no preferential advantage to South Africa, though at first sight it appears such. Did the one shilling preference actually apply to our unmanufactured leaf, the favourable verdict of the manufacturers on the subject of the quality of our leaf mentioned above indicates that we might expect to find a market for our bright cigarette tobacco in competition with America. As it stands at present the so-called preference to South African tobacco applies effectively only to cut pipe tobacco and to plug.

I venture to think these facts are worthy of attention in connection with any reconsideration of the Australian-South African preferential tariff which I gathered was under contemplation.

The quantity of tobacco grown in the whole of Australia is little, if any more than in Rhodesia. Although soil and conditions appear in many places favourable and in spite of a bounty of 2d. per lb. granted during the past five years, but now stopped, the production of this crop has in the past been checkered. Air-curing is largely practised in Australia. It would appear that one of the main causes of the comparative non-success of tobacco is the want of suitable skilled and unskilled labour. In Tasmania the early frosts have been found to render tobacco too precarious for it ever to be a success.

The Government in the Australian States have not done as much to assist tobacco growers as in Rhodesia. Queensland has a tobacco expert attached to the Department of Agriculture. A leaf expert employed by Messrs. Wills, Ltd., gives his services during certain seasons to the Government for purposes of advising tobacco growers in New South Wales.

TRANSPLANTING AND TREATMENT IN THE FIELD.—Contrary to the opinions expressed in most American works on the subject, I am a firm believer in a large plant; it can hardly be too big, in reason, so long as it is healthy, and has not been checked in the bed. Colour is the best guide in this respect. A pale yellow, sickly-looking plant rarely makes satisfactory growth in the field. The seed bed is well soaked before beginning to draw plants, so that they come out easily. The tap root of each is snipped off when taken from the bed; they are then packed in boxes, and carried to the field. The usual planting distance is 3ft. by 3ft. The rows are marked off by a home-made marker, which is drawn by a horse, and marks four rows at a time. The field is marked both ways. This saves a lot of time in planting, as the exact spot for each plant is clearly shewn wherever one mark intersects another; and, further, it permits of cultivation both ways subsequently. Planting pegs with iron points are used, and there is always difficulty in teaching new "boys" to tighten the plants properly. The tendency is to tighten them at the surface, and leave the root hanging in a hole. Plants treated like this will stand still for weeks, and, unless the weather is favourable, will die. The soil must be pressed firmly against the roots. Unless the weather is very dull and showery, the soil is heaped round the plant when planting to protect the heart, to be removed about the third or fourth day, when the roots have struck.

As soon as the plants are well established, cultivation should begin, and it cannot be repeated too often. A horse hoe may be used while the plants are still small, but if a supply of labour is available, I prefer hand hoeing. This must be done at intervals, both for the purpose of destroying weeds and conserving moisture, until the blossoms appear. Topping then becomes necessary. It is difficult to describe on paper just how this should be done; any number of leaves from eight to sixteen may be left, dependent upon the size and robustness or otherwise of the individual plant. At the same time the tobacco should be primed. By this is meant the removal of the bottom three or four leaves, which are usually damaged or mis-shapen.

Suckering will next call for attention; this will be necessary about a week or ten days after topping. By this is meant the breaking off of the young shoots which spring from each

leaf axil, in an attempt to form seed heads in place of the main stem which has been removed by topping. They may be much more easily removed while young and brittle than if allowed to become older and more fibrous. Suckering may be done once, twice, or a number of times, dependent upon the nature of the leaf. The object is to cause the sap, which would naturally have gone to form seed, to flow into the leaves and give them more body. If the leaf has a tendency towards heaviness, it will be well to sucker only once, afterwards permitting the suckers to grow up and blossom. Indeed, in some cases it may be wise not to sucker at all.

Harvesting and Curing.—The bottom leaves of the plant will be the first to mature. Indications of ripeness vary in the different classes of leaf. In the case of really light leaf, harvesting should commence when the colour becomes a light yellowish green : this type of leaf will never crack when bent double between finger and thumb. The heavier leaf will become spotted and break clearly when pinched up in the fingers. It will be found advisable not to commence reaping before 9 a.m., as in the early morning light it is difficult to distinguish the ripe leaves from those which are green. The leaf is loaded on wagons and carted to the barn. It is then tied on sticks (in the shade) in bunches of three, and hung at once in the barn. The barns used are 16ft. by 16ft. and 6 tiers high. A barn of these dimensions takes about 1,000 sticks, which will yield on an average 1,000 lbs. of cured leaf. It is impossible to lay down a definite set of instructions for curing; practically no two barns are treated exactly alike ; so much depends upon the varying degrees of ripeness, lightness or heaviness of leaf, and atmospheric conditions. Successful curing can only be learnt by experience, and close attention to detail. The following is roughly the treatment applicable in the case of a barn of light, ripe leaf.

Immediately it is filled, the door and ventilators are closed, fire lighted, and the temperature raised to 90 degrees, at which point it remains for three hours. It is then raised as follows :—

to 95 degrees for 3 hours, then
100 ,, ,, 6 ,, ,,
105 ,, ,, 3 ,, ,,
110 ,, ,, 9—12 hours

or until the leaf is yellow enough to commence drying off. The temperature is then quickly raised to 120 degrees, when door and ventilators are opened wide until the thermometer drops to 110 degrees. This is repeated about six times, after which the barn is held at 120 degrees for about two hours. It is then raised quickly to 130 degrees, and allowed by admitting cold air to drop to 120 degrees. This is repeated three or four times. Then it is held at 130 degrees for two to three hours, with ventilators slightly open. Following this, it is raised 5 degrees every two hours until 150 degrees is reached, at which point it remains for about six hours. The critical stage is now passed, and it only remains to dry out the leaf and kill the rib. The temperature may be moved up to 160 degrees and held there until the last twelve hours, during which it is kept at 175 degrees. The fire is then drawn, door and ventilators opened wide, and 24 hours allowed for the barn to cool off. It takes five days to cure a barn.

The main points to be observed in curing are, first to get the tobacco yellow. Moisture is necessary for this; none should be permitted to escape until the tobacco is yellow. Do not wait until the entire leaf is yellow, or sponging will inevitably follow. If the lower half of the majority of leaves is yellow, it is time to start drying. Go as fast as you can without splotching, but it is always safer to go slowly even at the expense of a little sponging, rather than too fast and cook the entire barn.

The leaf is now cured, but so dry and brittle that it will break into powder if grasped. It must be ordered or softened so that it can be handled without breaking. This is done by the use of steam, generated in a 400-gallon iron tank, and conducted to the barn in a pipe. This pipe goes right across the barn a little above the flues, and is perforated with small holes every three inches, on each side, thus distributing the steam evenly. Care must be exercised in ordering not to get the leaf too damp, or it will run dark in colour or even go mouldy. When the lower halves of the leaves, which first come in contact with the steam, are soft enough to grasp firmly in the hand without breaking, the tobacco may be taken out of the barn and bulked on the sticks in a close room, or preferably an underground chamber. During the night the moisture in the

tips of the leaves will spread through the drier parts; the whole bulk should be ready to take off the sticks the following morning and go straight to the baling press.

Pests.—Leaf caterpillars and cutworms sometimes appear in the seed beds. These can practically be wiped out in one night by spraying with Paris green. The plants have been noticed each year to die off in the beds in circular patches from 6 to 18 inches in diameter. I can offer no explanation for this; but an application of fertiliser has a stimulating effect which appears to check it.

Hand picking has been found the only effective way of dealing with cutworms in the field, but only small patches have been affected. By far the most destructive pest is wireworm, which eats off the plants after they are put out in the field. No effective method has been found for dealing with this pest. Poisoning cannot be carried out, as it works beneath the surface. The experiment was tried of treating 10 acres with apterite, at the rate of 200 lbs. per acre, broad-casted and ploughed in. This treatment had apparently no effect whatever. Great damage was being done by a worm which locates itself in the stem of the plant, causing a characteristic circular swelling of the stem itself. The plant stands still and never makes any progress; only on rare occasions does it outgrow the effects of harbouring this pernicious invader.

In conclusion, the following observations may be made :— New land produces the brightest leaf. It is not advisable to grow tobacco more than three consecutive seasons on the same land, and preferably only two. The leaf gets darker each year. This is said of land which has been fertilised each season. It pays to use fertiliser, which assists the plants to make a quick start, as well as having a good effect on both quantity and quality of the crop. Two hundred pounds per acre of "Safco" is a satisfactory application : it may be broadcasted or harrowed in just before planting. Do not plant tobacco unless you are prepared to give it personal attention. It is not a crop which can be left to take care of itself. It is probably not wise to look too far into the future; but it may be said, with some conviction, that tobacco is to-day, and probably will be for some years to come, one of the most remunerative of our Rhodesian farm crops.

CHAPTER X.

Sumatra Tobacco: Hints to Rhodesian Growers.

(By Dr. C. J. Sketchley.)

In view of Sumatra tobacco now being grown by quite a number of farmers, a few notes on the subject from one who has grown this variety largely for over fourteen years in tropical countries, may be of interest.

Sumatra leaf tobacco is grown and used almost exclusively for the outer wrapper of cigars. It should be of a fine silky texture, very thin, tough, and elastic, and it must be essentially of good burning quality; shewing a white ash, burning evenly round the cigar, and it should hang on tenaciously until shaken off by the smoker.

Good Sumatra tobacco has little or no flavour, although in some countries it develops a flavour peculiarly its own, and is then used for blending purposes, as well as for wrappers. I have known cigars made from a blend of Sumatra, Cuban, and Zimmer Spanish tobaccos, with Sumatra wrappers, all grown on the same plantation, to fetch a high price on the London market. The reason for the great demand for Sumatra leaf for wrappers is, that while Havana leaves will only go from 40 to 60 to the lb. weight, Sumatra will give from 120 to 140 to the lb.; and, as each leaf of from 12 to 14 inches long will cut from 8 to 10 wrappers, it will be understood that for this purpose Sumatra tobacco is more economical than other tobaccos (although costing from 4/6 to 8/- and 10/- per lb.), whose burning qualities are not so good, whose texture is coarser and lacking altogether the elegant finish of the Sumatra covered cigar.

The origin of Sumatra tobacco is unknown, though it is stated that it is indigenous to Sumatra, and has been used by the natives there for ages. This is instructive, as it is always supposed that all tobaccos came from the American continent

originally. It is said that the small leaved Turkish tobacco was originally Maryland tobacco, which, from climatic causes and conditions, has assumed a type unlike any other tobacco. It is curious how tobacco introduced into a new country will assume in a few years a distinct type of leaf and aroma; in many cases quite distinct from the parent plant. I have proved by my own experience that Sumatra tobacco grown under tropical conditions several years in succession, from seed saved locally, has deteriorated in a remarkable manner as wrapper leaf, although it has improved in aroma and texture as a filler tobacco. Therefore, if the object was to produce first class wrapper leaf of an even quality, from year to year, it was found necessary to import the seed direct from Sumatra each year. It is quite feasible that, by selecting the best plants, and collecting the seed for a few years, a distinct type of Sumatra tobacco might be grown here, which would be very useful to cigar makers, if not of the finest type for wrappers.

I am inclined to believe that a finer tobacco could be grown here for wrappers from Sumatra seed than the Connecticut seed leaf, which is so largely grown for the purpose in America. But all these problems require to be solved, and this is, in my opinion, the work of the Government Experimental Farm. There are few men here who have any knowledge of cigar tobacco growing, and experiments by others are costly and unsatisfactory. My experience here for the last nine years is that Sumatra tobacco leaf thickens, and becomes very similar to the Java type. Java tobacco was first introduced from Sumatra, and although it fetches a much lower price in the markets than Sumatra, it is in fair demand for cigar fillers, and pays well to grow. I think it likely that Sumatra grown here will develop into this type.

It is quite possible that a high class fine leaf could be grown here on the system adopted in Florida and Cuba—that is, to cover the whole plantation with a framework of sawn timber or poles, covered with limbo or canvas, which has proved such a success in those countries; but it is needless to say the cost in Rhodesia would be prohibitive.

Sumatra tobacco loves a hot, moist climate and a rich leaf mould. Under favourable conditions it is a rapid grower. I have made seed-beds on the banks of tropical rivers, in rich sandy soil, with a temperature during the day of 80 degrees to

A Large Fermentation Pile, Ohio.

86 degrees F., and at night 76 degrees to 80 degrees F. Three weeks from sowing the seed, the plants were 5 inches high, and ready to plant out. Two months later the crop was ready to harvest, the plants being 6 ft. high, with an average of 18 to 22 leaves to a plant.

To grow a fine leaf, the plants must continue growing without a check—the more rapid the growth, the finer the texture of the leaf. One drawback here is that, as soon as the rains commence, the temperature falls. To attempt to grow a fine, delicate leaf during the hot dry spell before the rains, even under irrigation, would, I am afraid, be hopeless, as the production of a fine leaf depends chiefly on heat and a moist atmosphere.

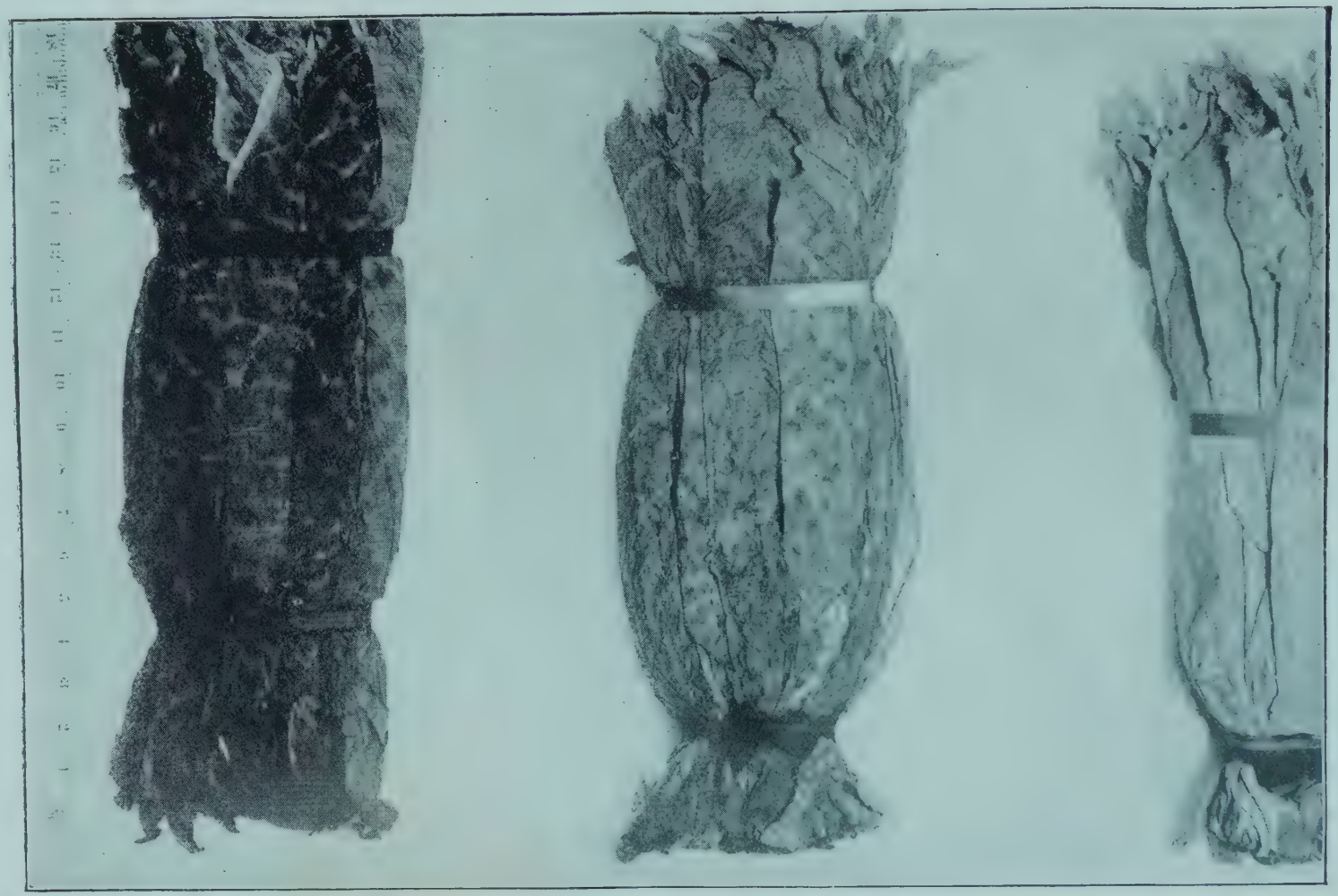
I am now experimenting with seed kindly sent me by the Agricultural Department. I have enough plants to grow about two acres. One acre I shall "Safco" heavily; the other I shall leave to natural conditions. I shall plant on the richest soil I have on the river banks.

My method of growing Sumatra is as follows:—I first procure the best and purest seed I can obtain, preferably direct from Sumatra. To prepare the seed beds, I dig over the land and well burn it. Mealie stalks do very well, and should be piled 3 feet high, covering the whole of the land required. I then hoe in the ash, and rake it over evenly; I dress the land with a good application of "Safco," or other good fertiliser, and rake it in. I then lay out the beds 4 feet wide by 40 feet long, rake evenly and pat down the surface with a spade, hoe, or roll it. I then water it thoroughly, so that it is wet down 6 inches or so. Early the following morning, before the wind rises, I mix one dessertspoonful (not heaped up) of seed with an ordinary wash basinful of sifted wood ashes. These I mix thoroughly by passing several times through a sieve. I then sow evenly by sprinkling it broad-cast, going down the bed one way, and up the other, to ensure even distribution, for which the white ash is a good guide. I then roll or pat the surface firmly with spades, and cover it evenly with long dry grass about half an inch thick (care must be taken that the seed ends of the grass be cut off, or you will be raising a fine crop of grass with your plants). Water well over the grass two or three times a day. In five to eight days the seed will germinate, and as soon as it is seen through the soil cover it with

limbo, or, as I prefer, make a framework of sticks about 12 or 16 ins. high round the beds, and lift the grass on to the framework, to shade the young plants from the hot sun. The beds should now be watered three times a day—in fact, they should never be allowed to get dry. If any check occurs, a tablespoonful of ammonia sulphate in each 3 gal. watering can, applied every two or three days, will soon make a difference, and the plants which look sickly will assume a healthy dark green. If cut worms or other leaf eating pests give trouble, an application of arsenate of lead sprayed over the plants will at once rectify this trouble.

The plants should be big enough in four to six weeks to set out, and they should then be from 5 to 6 inches high. I may say here that it is a great mistake to put out plants when too small. A big strong healthy plant can stand a dry spell after planting, whereas a small undersized plant will simply be dried out. The land cannot be too well prepared by ploughing and cultivating. Ridging is now the fashion, but in any case the plants should be set in rows 3 feet apart, and 2 feet to 2 feet 6 inches apart in the rows. An application of a teaspoonful of "Safco" should be applied round each plant, or if ridged, it can be sown with an ordinary one-row mealie planter on the ridges. Constant cultivation is necessary, until the plants are 2 feet high, when all the labour should be hand work. The plants should be constantly watched for cut worms, caterpillars and other pests, as a leaf with holes is useless for wrappers. Suckering and topping must be done as with ordinary Virginia tobacco, but the topping should be left until the crop is a uniform height, say 5 to 6 feet, although perhaps $4\frac{1}{2}$ to 5 feet will be the maximum height here in most cases.

After topping, the plant rapidly matures, and should be harvested either by the single leaf system, or by reaping the whole plant. It is usual to leave from 16 to 22 leaves on each plant. If the whole plant is cut, it should be hung in the barn on sticks or wires, and the whole mass in each tier should be pushed close together, and left so for two or three days to yellow. It must then be spread apart for the air to circulate amongst the tobacco to dry it out. If the weather is too moist, or a rainy spell sets in, the tobacco is liable to get what is called "pole burn," a mould which forms on the leaf, but if



Dark Mahogany, Light and Lemon Wrappers.

small fires 10 or 12 feet apart are made under the tobacco, it will soon disappear. This can be prevented by a timely application of the fires, which need consist only of five or six small sticks each.

The leaves can be stripped as they ripen on the plant, by the leaf system. The leaves are then placed on the ground on dried grass, in layers about 10 to 12 inches high, and covered again with grass, for two or three days, when they can be tied in bundles and hung in the barn to dry. When the mid rib is thoroughly dry and crisp, the tobacco is ready to strip and sort. Leaves of 10, 12, 14, 16 and 18 inches each should be kept separately. They should then be graded, each length being sorted into three shades, viz., light, medium, and dark, each shade being kept together. They can then be stacked in bulk to ferment, and here the art of the experienced grower comes in. If bulked too moist, too high a fermentation will set in; and if the tobacco is not moist enough, it will perhaps not ferment at all. A piece of the floor is marked off for the stack, which should be from 8 feet to 12 feet wide, and of any length. A number of logs are laid on the ground, and these are crossed by smaller sticks, which are covered a foot or so with sweet dried grass. If the grass is covered with a wagon sail, all the better. The tobacco is tied in bunches (hands) of 12 or 14 leaves with a piece of "tamba" or twine, and then laid in rows on the sail, butts out, in two rows, the tips of the leaves just crossing or overlapping. The next two rows are then placed in position, butts to butts, and so on until the first layer is laid the whole width of the stack. The next layer must be laid from side to side in the same manner, but crosswise, the bunches pointing from end to end of the stack, and so on, reversing each layer until the stack is complete. The larger the stack, the better the tobacco will be, if in proper condition, up to 10 tons. It will be necessary to place a thermometer in the stack every 3 or 4 yards, about half-way up the stack from the bottom, in a hollow bamboo, or a long box made of laths. The thermometer can be pushed in with a stick, and can be drawn out by a string tied to it. The stack should be covered with a wagon sail; in tropical countries rush mats are used. If the temperature should rise above 120 degrees F., re-stack the tobacco on an adjoining site, in the same way as before, when the top layers will be at bottom and bottom at top, ensuring

an equal fermentation. If the stack does not rise above 120 degrees, then let it stand until it cools down to the outside temperature, when it is ready to bale and ship.

When shipping tobacco to England, I have found it better to handle it in this manner, and ship it direct to tobacco "handlers," who re-sort the leaf into the proper number of shades and grades, re-bale it, and prepare it for the auction sales. In no case have I paid more than ¾d. per lb. for this work.

To attempt to sort the leaves into the requisite number of shades, as is done in Sumatra by expert Chinamen, with the labour we have at command here, would be simply hopeless, as something like sixteen shades and grades are required. About sixteen years ago, there was a craze for a dark olive green tint. This was obtained by harvesting the tobacco about two weeks before it was ripe, but the most desirable colour is a bright cinnamon brown, as all leaf darkens more or less when damped for wrapping cigars. Some of the drying sheds used in Sumatra are enormous structures, 150 feet by 150 feet being an ordinary size, and always built of poles and grass. Some of the companies growing tobacco there have a capital of £250,000 to £350,000, and pay dividends as high as 75 per cent. I should be very pleased to see Sumatra tobacco a success in this country. We have made both Virginia and Turkish tobaccos a decided success, and why not Sumatra, even if it is not of the highest grades, which would be expecting too much.

In closing, I would impress upon all farmers who are trying Sumatra, to remember three things :—

(1) Keep the plants growing as rapidly as possible from sowing the seed to harvesting.
(2) Don't allow a grub or insect pest to injure a leaf.
(3) Use great care in cultivating the crop while growing, during harvesting operations, and when handling the leaf at all times, as broken and worm-eaten leaves are useless for cigar wrappers.

CHAPTER XI

Rhodesian Tobacco : Prospects of an Australian Market.

By Eric A. Nobbs, Ph.D., B.Sc. (Director of Agriculture).

Every outlet for our rapidly increasing production of tobacco demands attention whether it be small or considerable, prospective or immediate. To this end I carried with me to Australia samples of our unmanufactured leaf of different grades supplied by the Warehouse as characteristic of large quantities, also samples of pipe tobacco and cigarettes manufactured from Rhodesian leaf by the Tobacco Company of Rhodesia and South Africa, Ltd., of Bulawayo, and three coast firms. The object was to ascertain the prospects of a market in Australia, to introduce our tobacco to the notice of manufacturers and dealers and to learn their views thereon. The accompanying notes will convey the impression gained.

I called upon seventeen firms of manufacturers, tobacco importers, dealers and retailers, enquiring as to the prospects for Rhodesian tobacco, exhibiting my samples, calling attention to our products and discussing generally with them conditions of the trade.

I have brought together the opinions expressed to me in the following notes, and I may say that I found a very general agreement in the views expressed.

A number of the larger tobacco manufacturers are understood to be united in a trust, although this is denied by them. The so-called combine appears to be mostly concerned in cigarettes, and keenly interested to secure suitable leaf which it is having increasing difficulty each year to obtain. If this alliance of big manufacturers can be induced to take our tobacco, which it seems is only a question of prices, and is not unlikely, it would want it in enormous quantities.

Other manufacturers are experiencing difficulty in getting bright cigarette cutters and are on the outlook for fresh sources of supply, but at present the difference in price is too great. These remarks refer only to our bright leaf; there is little prospect for the sale of our darker samples and heavier pipe grades of leaf.

Both the raw and manufactured tobacco are much admired on their merits and also as forming an attractive novelty. They agreed that to establish its popularity systematic and active advertising was required. All our manufactured lines elicited admiration on account of brightness, aroma and combustibility, in which they appear far to excel the generality. Competent judges refused to credit the absence of scents and flavouring essences, even when this was distinctly indicated on the labels, but were always struck by its characteristic flavour. The Invicta brand, manufactured by Messrs. Hermann and Canard, though but lately introduced, is already established on the market and was very favourably commented upon by the firms handling it, both wholesale and retail, and is likely to become quite popular when it is better known.

Importers and retailers were much interested in the different brands of cut tobacco I was able to shew them, and expressed a desire to communicate with the manufacturers, particulars regarding whom I supplied. The pipe tobacco which is most popular in Australia is that which sells by the million at 10d. or 1s., put up in 2 oz. tins. There is evidently a better prospect for the sale of our pipe tobacco than for our cigarettes or raw leaf and a large business is likely to grow up. The landed cost, including the duty of 2s. 6d., should be so fixed as to enable it to be retailed at 1s. per 2 oz. packet. Further, it was made evident that brands of cut tobacco must be packed hermetically, and that the labels of different strengths should be of different colours or tints to facilitate handling. If entire freedom from flavouring essences of all kinds can be guaranteed it is well to emphasise the fact on the labels. Manufacturers should send full ranges of their various lines to their representatives in Australia and meet their peculiar requirements indicated above as far as possible, even supplying them, if desired, with an exclusive blend. It was suggested that to attract attention to our tobaccos specially low

Tobacco at Sleamish Farm, Mazoe.

prices should be quoted for the first couple of consignments or for the first few months, so as to get these unknown brands on to the market, making it quite clear to the firms concerned that this is only a temporary measure.

Plug tobacco seems to be largely consumed in Australia, and enquiries for this type from Rhodesia were made. Certain peculiar standards as regards size and weight are insisted upon. The want of a light and bright plug is specially emphasised. It seems likely that there is an outlet for our medium and dark leaf in this direction. Plug tobacco enjoys the advantage of the preferential rate and requires a minimum of labelling and packing. Australian plug tobacco is highly flavoured with all sorts of ingredients to try to impart to the inferior leaf the aroma which ours naturally possesses.

As regards cigarettes, there is no preferential tariff, the rate on all importations being 6s. 6d. per lb. The chief demand in Australia is for cheap lines with a brilliant label outside and an attractive picture inside. There is, therefore, likely to be difficulty in introducing and establishing Rhodesian cigarettes whatever the quality may be. The opinion seemed to be that our cigarettes were not able to rank with the highest class of cigarettes de luxe, nor, on the other hand, to replace the popular favourites, especially at present prices, but that under certain circumstances a good business might be built up.

Rhodesian cigarettes to retail at 9d. or 1s. for 10 would have to be offered at low prices to the trade, and they would need to be got up in different and more ornate style—preferably in boxes. It seems unlikely that this can be economically done in Rhodesia, as packing materials, etc., have first to be imported. Even then the sale would not be large, as the great demand in Australia is for the cheap local article, familiar, well advertised, and attractively packed. The quality of our Rhodesian cigarettes was warmly approved, but quality seems to be a subordinate consideration in Australia.

The economic tendency of Australia is towards the importation of raw produce to be worked up by Australian labour for Australian consumption, especially as regards cigarettes

and cigars, less so as regards our pipe tobacco and plug. Raw leaf as graded by the warehouse can, of course, only be sold to the manufacturers. These are limited in numbers and include some very large and a few small firms. Rhodesian bright leaf would compete in Australia as in South Africa with the Virginian type from the United States, and with locally-grown leaf. For our pipe qualities and our short medium bright leaf there is no prospect of a market at the Rhodesian price of 1912, 8d., 10d., and 1s. 2d. per pound. Small leaf with a large proportion of stalk entails too much expense in handling under Australian conditions of dear labour. Our heavier leaf resembles the best class of Australian grown air-cured tobacco, which of course has no protection of the tariff, and is therefore precluded from competition. Our bright leaf—cigarette cutters—which at the 1912 sale in Salisbury fetched from 2s. 9d. up to as high as 3s. 4d. is comparable to leaf from the United States, which was bought last year at 1s. per pound in Australia, and next year is likely to be dearer, perhaps 1s. 3d. or 1s. 4d. Tobacco of this class is in great demand, and, if prices suited, would find a ready sale amongst Australian manufacturers, but leaf which at our 1912 sale fetched 2s. to 3s. is at present bought in the United States for 10d. to 1s. As regards duties, America and Rhodesia are on precisely equal terms in Australia for this leaf. The price is constantly rising in the United States. It is recognised in Rhodesia that our prices must fall somewhat as supplies increase and the industry approaches normal commercial conditions. Ere long leaf of this type may therefore become saleable in Australia. Rival manufacturers agreed upon these points and did not regard business as out of the question by any means—indeed, they were enthusiastic as to the merits of our leaf. The difficulty in getting American leaf of the quality desired and similar to ours is increasing year by year, and is felt over the whole world. It would probably be best to treat Rhodesian bright leaf as an altogether new line and to introduce it as such, purely on its own merits, which are recognised, and on its own characteristic flavour and aroma. Turkish tobacco elicited little interest and did not seem to be known or appreciated. A small quantity of this type is grown in Queensland. Curiously enough all the manufacturers assured me that there

Tobacco at Uplands Estate, Marandellas.

Tobacco Field and Flue Curing Barns, Uplands Estate, Marandellas.

would be no market in Australia for our brands of our pipe tobacco and cigarettes made in South Africa, but the evidence and experience of importers and retailers is otherwise.

On my arrival in Australia I was faced with some difficulties regarding the duty levied on different classes of tobacco amongst the samples I took over. This raised the whole question of the preferential rates granted to South African tobacco, and on this subject I had several interviews with the Federal Minister for Trade and Customs, the Hon. Frank G. Tudor, and with Mr. Lockyer, the Comptroller General.

There appears to be some disparity in the terms used in the Customs Tariff (South African Preference) Act, 1906, and the Customs Tariff of 1911. As it was desirable to secure a clear ruling on the point it was arranged that I send certain samples to the Customs authorities and receive their decision as to classification. The samples referred were as follows :— Dark leaf suitable for pipe, medium bright short leaf, cigarette cutter bright leaf and Turkish leaf; also Connaught and Kingsdown cigarettes in packets and tins of cut pipe tobacco of Matabele mixture and Ambrosia brands.

As a result of these enquiries it appears that under the present interpretation of the tariff cigarettes do not enjoy the preferential rates. South African tobacco leaf pays 2s. 6d. on being imported with a preference of 1s.; and if manufactured would have to pay the excise of 1s. in addition. Such tobacco in bond enters Australia under Item 21 from any part of the world at 1s. 6d. in bond plus 1s. excise on manufacture. This is therefore no preferential advantage to South Africa, though at first sight it appears such. Did the one shilling preference actually apply to our unmanufactured leaf, the favourable verdict of the manufacturers on the subject of the quality of our leaf mentioned above indicates that we might expect to find a market for our bright cigarette tobacco in competition with America. As it stands at present the so-called preference to South African tobacco applies effectively only to cut pipe tobacco and to plug.

I venture to think these facts are worthy of attention in connection with any reconsideration of the Australian-South African preferential tariff which I gathered was under contemplation.

The quantity of tobacco grown in the whole of Australia is little, if any more than in Rhodesia. Although soil and conditions appear in many places favourable and in spite of a bounty of 2d. per lb. granted during the past five years, but now stopped, the production of this crop has in the past been checkered. Air-curing is largely practised in Australia. It would appear that one of the main causes of the comparative non-success of tobacco is the want of suitable skilled and unskilled labour. In Tasmania the early frosts have been found to render tobacco too precarious for it ever to be a success.

The Government in the Australian States have not done as much to assist tobacco growers as in Rhodesia. Queensland has a tobacco expert attached to the Department of Agriculture. A leaf expert employed by Messrs. Wills, Ltd., gives his services during certain seasons to the Government for purposes of advising tobacco growers in New South Wales.

CONCLUSION.

The development of the tobacco industry has been the work of four centuries, during which time many facts have been ascertained by experience, some learned by accident, and others by careful scientific investigation.

The planters of a country in newly taking up the culture of tobacco need not go through all the varied steps, and themselves experience all that the older countries have done, for they have at their command the accumulated knowledge of the rest of the world. At the same time, the new country cannot start out full-fledged in the industry, for there are local, climatic and soil influences to be determined, and labour conditions to be adjusted, as well as markets to be found.

The first step in the culture is the experimental stage, and, before starting this work, the experimenter should be thoroughly informed as to the nature of the tobacco plant and its requirements, for if he is not, the causes of the good or bad results obtained will not be understood, and the conclusions drawn will be faulty and of little value. One year's carefully-planned, intelligently observed, and accurately recorded experiments will be of more value than twenty years of experiments carelessly conducted.

Next, after favourable results have been obtained in the experimental stage, comes the period of commercial expansion. Labour must be secured, retained, and trained, because a large tobacco industry is not likely to be established with an irregular, untrained labour supply.

Then comes the question of the development of the markets. The world really wants new superior tobaccos, but is somewhat slow in discovering them when they are produced. A bad tobacco is not wanted, unless the consumer, through long usage, has become accustomed to the bad tobacco, and

perverted his taste. The production of an unusually high-grade tobacco with an established reputation will pay under most adverse conditions of transportation and expensive labour.

Extreme care must be exercised in the packing, and it is to be hoped that the remarks in this connection contained in a previous chapter will be carefully noted and acted upon.

Growers must realise that to build up a profitable industry a high-class tobacco must be produced, and now that a demand has been created for Rhodesian leaf, every effort should be made to improve the quality. No matter what the inducement may be, never lower the standard of quality, or the industry as a whole will inevitably suffer.

Rhodesia has a climate and soil in certain districts favourable to the production of high-grade tobacco. It may be that certain localities are adapted to a superior leaf; if this be so, settlers in those localities are to be congratulated, for the production of high-grade leaf ensures prosperity. Nothing can be fully determined without experiments, which, properly conducted, will give us our answer, and point our way to the future.

The Mechanical Composition of Rhodesian Bright Tobacco Soils.

Rhodesian Granite Soils.

Laboratory Number	Coarse Gravel over 3 mm. %	Fine Gravel 1—3 mm. %	Coarse Sand ·2—1 mm. %	Fine Sand ·04—·2 mm. %	Silt ·01—·04 mm. %	Fine Silt and Clay (by difference) under ·01 mm. %	Water and Organic Matter %	Calcium Carbonate %
*119	0·22	21·01	50·53	15·22	4·57	6·31	2·14	...
†120	0·20	22·04	45·63	14·68	4·42	10·49	2·54	...
*122	0·87	11·09	44·68	24·65	8·43	6·66	3·61	0·01
†123	1·42	11·51	35·67	26·04	9·66	9·23	6·45	0·02
*124	0·72	9·74	42·81	31·17	6·95	5·81	2·80	...
†125	0·63	9·38	41·76	25·96	9·72	9·26	3·29	...
*107	0·30	3·65	40·90	34·20	9·13	7·67	4·13	0·02
†109	6·05	3·61	34·87	32·46	7·58	10·83	4·57	0·03
*441	0·00	3·98	32·06	30·91	7·61	20·24	5·20	...
†442	0·04	5·53	25·30	22·57	8·00	30·36	8·20	...

Rhodesian Sandstone Soils.

*321	0·00	0·61	22·97	69·51	1·00	4·06	1·83	0·02
†322	0·00	0·06	24·83	67·98	0·82	4·74	1·55	0·02
*315	0·00	0·08	44·80	43·90	1·66	6·80	2·75	0·01
†316	0·00	0·09	46·82	42·12	1·18	7·37	2·41	0·01
*317	0·00	0·03	16·88	76·85	0·77	4·03	1·42	0·02
†318	0·00	0·08	18·21	74·74	0·81	4·88	1·25	0·03
*319	0·00	0·49	35·82	55·47	0·95	5·29	1·98	...
†320	0·00	0·56	33·65	56·80	1·24	5·89	1·86	...

* First 9 inches from surface

† Second 9 inches from surface